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The Canadian Manufacturing Sector: Adapting to Challenges

by John R. Baldwin and Ryan Macdonald

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Statistics Canada
Economic Analysis Division
R.H. Coats Building, 18th floor, 100 Tunney's Pasture Driveway
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Abstract

This paper examines the challenges that the manufacturing sector has faced over the last half century—focusing on both long- and short-term performance. It first examines whether there is evidence that this sector is in long-term decline. The paper also investigates how the industry has responded to specific shocks during this period—from exchange-rate movements, trade liberalization and business cycles. It finds little evidence of long-term decline. Rather, it describes how manufacturing has adapted to varying challenges, whether from demand shifts due to business cycles, relative price shifts associated with exchange rate shocks or changes in tariff regimes.

Executive summary

In this paper we focus on the challenges that the manufacturing sector has faced over the last half century by examining long-term trends and short-term shocks that affected the industry. We focus first on the issue of deindustrialization and whether there is evidence of the industry being in long-term decline. Deindustrialization is almost always examined using a relative metric such as the share of manufacturing in nominal GDP or the share in total employment. In Canada, these shares have fallen over the last 45 years, though somewhat less than in many other industrialized countries.

There are two reasons why the share of value-added (GDP) is a poor measure for determining if deindustrialization is occurring. First, the share of GDP depends not just on how the manufacturing sector performs, but also on how all other areas of the economy perform. Second, shares reflect the fact that the nominal value of GDP has both a volume and a price component: movements in each have different implications for the deindustrialization hypothesis. Analysis of nominal GDP or employment shares tends to overlook the effect of the relatively large productivity growth in manufacturing on relative prices of this sector. Declines in relative prices are not indicative of a sector that has become moribund; rather they indicate that manufacturing has been undergoing rapid technological change.

Next, we examine how the manufacturing sector has responded to specific shocks during the last 45 years: from exchange rate movements, trade liberalization and business cycles. Economic shocks emanating from these sources can accelerate, decelerate and even reverse the declines in manufacturing's share of economic activity.

Looking at long-and short-term influences on manufacturing, the picture that emerges is not one of large-scale deindustrialization in Canada. Rather, manufacturing volumes between 1961 and 2005 kept pace with overall growth in the volume index of GDP. Manufacturing adapted to long-term changes in the economic environment, showing considerable resilience in the face of diverse challenges stemming from demand shifts, relative price shifts and changes in tariff regimes.

Throughout the investigation into the challenges manufacturing has faced in the last 45 years, several questions are explicitly addressed:

1. **Is Canada de-industrializing?**

   No. Discussions of deindustrialization in Canada focus on a supposed decline of the manufacturing sector. This dialogue relies upon statistics showing that manufacturing accounts for less and less of the total value of the Canadian economy's market output, and that the share of the value of GDP accounted for by manufacturing has been falling since 1961.

   The fact that manufacturing's share of the *value* of goods produced fell does not imply that the absolute or relative size of the *volume* of goods has fallen, which is at the core of the deindustrialization debate. The decline in the share of the value of GDP accounted for by the

manufacturing sector is not simply caused by a decline in the goods produced, since the value of GDP is comprised of both a relative price and a relative volume component.

The decline in relative overall value originating in the manufacturing sector comes from relative price declines and not relative volume declines. For Canada, relative volumes were essentially unchanged between 1961 and 2005. On the other hand, relative prices fell by 0.9% per annum, making them the primary source behind the declines in Canada's manufacturing share of the value of GDP. There is little evidence—when relative volumes are considered—that manufacturing was in a long-run decline

2. Why are relative prices of manufactured goods falling?

Manufacturing is the major source of productivity growth in the Canadian economy. Firms pass this productivity growth on in the form of lower price growth. As a result, prices of manufactured goods do not rise as rapidly as the overall price level; hence, a relative decline in manufacturing prices occurs. Between 1961 and 2005, manufacturing prices rose at an average annual rate of 3.5%, compared with 4% for services and 4.5% for goods. These relative price declines led to decreases in the share of nominal GDP accounted for by manufacturing.

3. Do the processes behind the share changes lead to smooth changes over time?

No. Between 1961 and 2005, changes in exchange rates, business cycles and trade liberalization accelerated, decelerated and reversed the share declines experienced. The result is an uneven adjustment, a process that has also occurred in other member countries of the Organization for Economic Cooperation and Development (OECD).

4. How do exchange rates affect the share of manufacturing in nominal GDP?

Exchange rate fluctuations affect the speed of relative price changes. The manufacturing sector has had to adapt to several exchange rate cycles over the study period. The cycles are associated with changes in the competitive pressures faced by Canadian manufacturers, as their domestic and export prices come under more (or less) pressure as the Canadian dollar appreciates (or depreciates) against the U.S. dollar.

One exchange-rate cycle corresponded directly to the period (the 1980s and 1990s) when Canada's share of manufacturing in GDP performed well. Canada's relatively 'superior' performance, compared to other OECD countries with respect to the share of the value of GDP produced in manufacturing, stems primarily from a different trend in relative manufacturing prices in the 1980s and 1990s. The downward trend in relative manufacturing prices in Canada tracked that of the United States in the 1960s and early 1970s, but then underwent a hiatus in the 1980s and 1990s. During this period the Canadian dollar underwent a long-term depreciation against the U.S. dollar that reduced competitive pressures on Canadian manufacturers. At this time, Canadian manufacturing relative prices stopped declining at the same rate of other countries.

This emphasizes the general problem of using the share of industry value added to infer whether or not the manufacturing industry is maintaining production levels. Prices are an important determinant of the share of value added originating in the manufacturing sector.

When there are exchange rate shocks prices can deviate from their long-term trajectory in a small open economy like Canada's. During the 1980s Canadian manufacturing prices deviated from their long-term trend (U.S. levels), and this contributed to a slowdown in the long-term decline in the share of manufacturing value added, creating the appearance of Canada's performance being superior to that of other countries.

5. How have business cycles affected the share of manufacturing?

The Canadian manufacturing sector is affected by business cycle shocks emanating from the United States. As a general rule, when manufacturing in the United States performs relatively well, manufacturing in Canada also does well and vice versa. Business cycle fluctuations, therefore, affect the speed of relative volume changes.

To investigate this relationship, the paper tracks annual changes in the relative volume of Canadian manufacturing against the U.S. Federal Reserve Manufacturing Capacity Utilization (CAPU) Rate Index. Between 1961 and 2007, Canada responded closely to changes in United States capacity utilization. During periods when U.S. CAPU is above its long-run average, Canadian manufacturing volumes rise faster than overall GDP. When U.S. CAPU drops below its long-run average, Canadian manufacturing volumes decline relative to overall GDP.

In Canada and the United States, manufacturing is more cyclical than the overall economy. In Canada, the manufacturing sector has been even more volatile than the manufacturing sector in the United States. Between 1961 and 2007, the standard deviation of the manufacturing sector's growth rates in Canada was about 10% higher than those of the United States, but the performance was very different in the first half and the last half of the period. In the first half of the period, Canada was more stable than the U.S. In the last half, it became more volatile than the U.S.

6. How has trade liberalization affected manufacturing's share of GDP?

Trade liberalization has dramatically reshaped the Canadian manufacturing sector's opportunities in U.S. export markets and heightened the intensity of competition from foreign producers. The Auto Pact in 1965, the General Agreement on Tariff and Trade's (GATT) Kennedy Round (1964-1967) and the Tokyo Round (1973-1979) of tariff cuts were followed by the 1989 Free Trade Agreement (FTA) with the United States and the North American Free Trade Agreement (NAFTA) between Canada, Mexico and the United States in 1993. The most dramatic episode was the adjustment to the free trade agreements that Canada underwent in the mid-to-late 1990s.

The largest relative and absolute gains in manufacturing output occurred during the mid–to–late 90's. As a consequence, the share of manufacturing in GDP rose through the 1994 to 2001 period as Canada adjusted to expanded trade opportunities.

7. Did NAFTA have any other effects on manufacturing shares?

Yes. It was predicted that NAFTA would bring benefits to those industries where access to larger markets would reduce costs because of the exploitation of either scale or scope economies. Between 1994 and 2001, durable goods industries expanded their shares within

manufacturing, while the share of non-durables contracted. In this respect, the Canadian manufacturing sector began to resemble that of the American manufacturing sector (as did the Mexican manufacturing sector). By 2005, the composition of the manufacturing sector had changed considerably from 1961, with most of the change occurring after the introduction of NAFTA.

8. What can we say about manufacturing overall?

Manufacturers in Canada have proven to be resilient and adaptive. Over the past 45 years, manufacturers have dealt with oil shocks, Canadian and U.S. recessions, trade liberalization (including the introduction of NAFTA), and the largest resource boom since the end of the Second World War. The resource boom was associated with a dramatic change in the relative prices of outputs and inputs and an unprecedented appreciation of the Canadian dollar. Throughout all of these events and in the face of intense international competition and rising resource prices, Canadian manufacturers raised their productivity by an annual average of 1.1%, shifting manufacturing shares in durable goods industries to resemble that of the United States.

Between 1961 and 2005, the volume of manufactured goods produced, relative to total goods and services, was approximately constant. More important, the actual volume of goods produced (the volume index of GDP in manufacturing) increased. The rate of increase was also positive during the 1990s after the implementation of NAFTA. During this time, growth was positive in non-durables (even though its share diminished) and in the durables sector (whose share increased). Productivity performance in durables was superior to that of the non-durables sector over most of the period.

In the years since the technology bubble burst in 2001 and during the resource boom, manufacturing growth averaged 0.4% per annum between 2002 and 2007. The compositional shift, towards durables and away from non-durables, continued. Durable goods volumes tended to increase over this period while non-durable goods production declined. Between 2001 and 2007, the volume index of GDP expanded across most durables industries and declined across most non-durables industries.

Despite the relatively high productivity growth in manufacturing, the demand for inputs used in manufacturing has grown. Over the half century examined, both labour and capital inputs (defined as labour and capital services) increased in almost all industries. The exceptions are labour inputs in beverages, leather and clothing—three non-durable industries. While hours worked have declined in the post-2000 period in both durables and non-durables, the shift from a lower skilled, lower paying workforce to a more highly educated one that began before 2000 has continued after 2000. Throughout the period, capital inputs have increased across all industries—even in those three non-durable consumer goods industries that have seen labour input decline. More importantly, the growth of capital inputs is greater than the growth in labour inputs, with capital services-labour ratios increasing universally across all industries. Over the period from 1961-2005, capital services increased more than 2.5 times the rate of labour services.

1 Introduction

The expansion of manufacturing during the industrial revolution of the late 18th and early 19th centuries came with the mechanization of agriculture, the development of automobiles, and steel and chemical plants. This produced new materials inputs for many other new products, including aircraft and super tankers, and critical war materials. So important was manufacturing that the modernity of a nation and its military power was measured by its industrial might.

A generation of economic historians has long-defined Canada by the success of its National Policy following Confederation, in which policy-makers set out to develop a manufacturing sector behind tariff walls and build a railway infrastructure to create a national market. More recently Canada has turned to special trade arrangements with the United States such as the Auto Pact or the 1989 Free Trade Agreement: all with the intent of fostering a strong manufacturing sector.

It is not surprising, therefore, that recent studies claiming that the manufacturing sector is in decline have garnered considerable attention, especially from the students of post-modernity (Agger, 1991) who worry about deindustrialization. Deindustrialization in common parlance refers to the process whereby the importance of industrial activity or capacity is reduced.[1] Industrial activity in this literature is frequently associated with the success of the manufacturing sector (Cohen and Zysman 1987 and Doyle 2002). Arneson (2006) attributes the origin of popular interest in deindustrialization to Bluestone and Harrison (1982), who defined the concept as denoting the removal or substantial reduction of manufacturing activity in a region or country.

One branch of deindustrialization studies has focused on evidence that deindustrialization is occurring. Noting that deindustrialisation is back on the policy agenda, an OECD study by Pilat et al. (2006) examines the extent to which manufacturing output and employment are declining. As evidence, it points to the fact that the share of manufacturing in value added at current prices has slowly declined as has the share of total employment accounted for by the manufacturing sector.[2]

The decline in manufacturing's share of the value of economic activity however, does not necessarily imply that manufacturing itself is in decline or, that it necessarily represents a deindustrialization of the Canadian economy. The decline in manufacturing's share of activity may be the result of other areas of the economy expanding more rapidly, or the result of a society starting to value services like education, health care or financial services more than manufactured products. More importantly, the decline in manufacturing's share of the *value* of goods produced does not imply that the absolute or relative size of the *volume* of goods has also fallen (which is at the core of the deindustrialization argument). Before we reach the conclusion that the economy is de-industrializing, we must examine the evidence that is commonly used to argue that there has been a decline in manufacturing industries.

1. See Wiktionary, MSN Encarta, Cambridge Dictionaries online for examples of current usage, Cairncross 1982, and Cowie, Heathcott and Bluestone 2003 for more extensive discussions of definitions.
2. See Kutchser and Personick, 1986 for a U.S. study of changes in the importance of manufacturing industries.

This paper examines Canada's performance in this regard. In doing so, it places Canada in context by examining what has been happening in other OECD nations, in particular the United States, Canada's largest trading partner. We are interested primarily in the trend in the importance of manufacturing—but we will also make reference to some of the factors that affect these trends. Krugman (1996), Kucera and Milberg (2003) and Spilembergo (2003) have focused on the extent to which changing trade patterns explain the reduction in the importance of manufacturing industries in developed countries. Rowthorn and Ramaswamy (1997) focus on underlying differences in productivity growth between manufacturing and other sectors. Kollmeyer (2009) evaluates the relative importance of changes in North-South trade, productivity differences, and differences in income elasticities for manufactured and service products. This paper addresses some of these issues by asking how the manufacturing sector has adapted to both long-term trends and shorter-run shocks coming from business cycles, exchange-rate fluctuations and trade liberalization.

We find little evidence of a moribund manufacturing sector in decline. We do find that manufacturing has undergone significant change in response to the numerous challenges that it faced.

2 Framework

The most common evidence cited in the debate over deindustrialization is the declining share of GDP produced by manufacturing. While it is true, as we shall see, that the value-added shares and the labour shares of manufacturing have declined over the past forty years (see for example: OECD 2006), this fact alone means neither that manufacturing is in inevitable decline, nor that the economy is de-industrializing, despite the use of this evidence by many commentators to conclude that manufacturing needs resuscitation.

A decline in manufacturing's share of GDP could simply be the result of other sectors undergoing faster growth than usual. A commodity boom favouring the resource sector may result in a diminution of manufacturing's share (a relative measure), even though it continues to grow in terms of absolute value.

A decline in manufacturing's share of GDP may also be a function of measurement issues. Statistical definitions of industries create artificial boundaries across economic activities conducted within firms. If a rising share of activity within a firm comes from activities where mechanization is more difficult (like marketing, management, financial and legal services, customer services, research and development, engineering or distribution), the definition of a manufacturing firm may prove problematic for classification purposes. Even if adjustments are made for the split between services and production-line activities within firms, the specialization that services provide prevents mechanization while ensuring that increases in labour input are larger in service activities. Further measurement issues present themselves as firms outsource. When manufacturers move from employing staff (whether it be for payroll, accounting, janitorial services or production), to contracting with outside firms, employment in manufacturing necessarily decreases while services employment rises.

More important, the deindustrialization hypothesis is about the volume of goods produced—either in absolute terms or relative to other goods produced. To use the share of GDP derived

from manufacturing to argue that deindustrialization is occurring is to forget that GDP is the total *value* of goods and services produced. Value has both a price and a volume component. GDP is greater if more goods are produced and if the prices received for the output are higher. The share of manufacturing in total GDP, therefore, can decline if the prices paid for manufacturing goods decline relative to prices in the overall economy. Manufacturing's share of GDP can also decline if the volume component (the amount of manufacturing goods) declines relative to the volume of total output. Even if the latter occurs, the absolute volume of goods may not be decreasing: it may be that the volume of manufacturing output is not increasing at the same rate as the volume of output in the economy as a whole.

It is therefore not possible to assess the health of the manufacturing sector based solely on whether the share of the value of GDP originating in the manufacturing sector has fallen unless relative manufacturing prices are constant. It is particularly important to note that a negative change in the value share is not necessarily a sign of difficulty within manufacturing: it may simply be the result of relative price movements.

Many factors affect relative price changes, one of the most important being productivity growth. Industries with higher productivity growth tend to pass the benefits on in the way of smaller price increases (Baldwin, Durand, and Hosein 2001). As a result, prices in these industries fall over time relative to goods and services produced in industries with lower productivity growth. Competitive processes and productivity growth together combine to hold back price increases in manufacturing relative to other industries or, to cause manufacturing prices to fall relative to all other goods and services. The relative price movements imply that changes in manufacturing's share of value added will face downward pressures that may be offset by changes in relative volumes. Whether this occurs depends on the price elasticity of manufacturing goods with respect to their own prices, the prices of other goods, and the income elasticity of manufactured goods: whether consumers, investors or governments buy relatively more manufactured goods over time as income increases, or whether they choose to increase their emphasis on services.

In Canada, the manufacturing sector has had higher productivity growth than average and makes the largest contribution of any sector to productivity growth (Baldwin et. al., 2001). Its processes are amenable to commoditization,[3] allowing for greater specialization of labour and higher levels of mechanization. This leads to particularly high rates of productivity growth. Innovations, whether they introduce new technologies, processes or organizations, lead to input savings from all input sources, including labour.

This suggests that the share of manufacturing output in GDP may not adequately reflect what is happening to relative volumes, which is the relevant measure for a debate on deindustrialization. Higher productivity growth in manufacturing also means that an alternative measure of the health of manufacturing (the share of total labour in the manufacturing sector), should be used with caution.

Employment growth in a sector is directly related to growth in output, but is inversely related to labour productivity growth. Labour productivity is measured as output per hour worked. All things being equal, industries with higher labour productivity growth will have relatively lower labour input growth; that is, their share of overall employment will be in decline. If manufacturing's output growth is as buoyant as the overall economy, its labour input growth will

3. The standardization of methods, tools and parts in order to facilitate interchangablilty and replicability.

be less than the overall growth in employment because of its superior labour productivity performance: manufacturing's share of total employment could be in decline simply because of desirable, fundamental increases in efficiencies on the productivity front. While this would result in relatively fewer opportunities for employment in manufacturing, it does not necessarily mean that manufacturing output is in decline nor that deindustrialization is present.

There is another reason to be cautious about using the share of manufacturing employment in arguments about deindustrialization. In the United States, manufacturers have outsourced considerable portions of their labour input requirements. Dey, Housman and Polivka (2006) report that the U.S. Bureau of Labor Statistics (BLS) estimates that between 1989 and 2000 manufacturing employment declined by 4.1%. However, if adjustments are made for manufacturers contracting-out for employment services, the number of employees attached to the manufacturing industry in the United States actually rose by 1.4% during this period. Estavo (1999) and Estavo and Lach (1999) also document an increase in manufacturer's contracting-out for employment services in the United States.

We will investigate several of the simple metrics that are used to assess the health of the manufacturing sector. We recognize that these share measures have both a volume and a price component and we will examine each in turn and ask what the trends reveal about the underlying economy.

In a closed economy, the way in which domestic demand responds to relative price changes depends on the size of the own-price elasticity of domestic demand for manufactured goods. This, along with other factors, will determine whether lower manufacturing prices result in sufficiently larger volumes of goods being demanded so that the share of manufacturing in the total value of production remains constant or rises. The productivity-driven forces pushing down the manufacturing shares (due to declining relative prices) could potentially be mitigated by changes in domestic volumes purchased.

In an open economy changes in major trading partners, combined with freer access to foreign markets, will also affect the success of the manufacturing sector. Over long periods, the productivity performance of the manufacturing sector is a major determinant of the movements in prices; in the short-run, major shocks will also affect prices. Short-run economic shocks caused by recessions are transmitted from one nation to another. Exchange rates appreciate or depreciate, thereby altering competitive pressure that Canadian manufacturers face. The introduction of new trading regimes also affects demand for manufactured products by changing the size of markets and reducing the prices of products where the exploitation of economies of scale reduces unit costs. Together, business cycles, exchange-rate shocks and tariff reductions lead to changes that alter the composition and size of a country's manufacturing industry. Depending on the size of the change and its sources, the adjustments that occur may take place quickly, or span many years.

The many factors that affect manufacturing at any point in time make it difficult to assess the health of the manufacturing sector using a single metric or a short span of data. This paper, therefore, uses a number of metrics to examine the evolution of Canadian manufacturing industries between 1961 and 2005. Section 3 discusses the different data sources employed, while Section 4 places Canada in an international context and explores the link between Canadian and U.S. manufacturing and discusses major changes in the share of the value of GDP accounted for by Canada's manufacturing industry between 1961 and 2005. It investigates

whether changes in the share of the value of GDP devoted to manufacturing was the result of changes in relative prices or of changes in relative volumes of manufacturing goods. It also examines the relationship between changes in manufacturing prices and productivity growth. Section 5 investigates the effect of exchange-rate shocks on Canadian manufacturing prices. Section 6 examines the impact of U.S. business cycles on the Canadian manufacturing sector. Section 7 contains a brief analysis of the impact of trade liberalization in the 1990s and discusses the evolution of durables relative to non-durables industries. Section 8 summarizes the evidence on forty-five years of growth and touches briefly on more recent events. Section 9 concludes.

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3 Data sources

The study draws on data from a range of sources. The OECD Structural Analysis (STAN) database is used for calculations across OECD nations of the share of GDP originating in manufacturing because it provides the broadest coverage, and price and volume movements. The STAN database contains estimates of nominal GDP, the volume index of GDP and price indices as far back as 1970 and as recently as 2006. It is used here to make comparisons with countries other than the United States. While data for cross-country comparisons are available from the OECD, users should be aware that output measures in OECD databases are not always measured consistently across countries with respect to market prices, basic prices or factor costs.

In addition, we use data for the United States that come from the National Income and Product Accounts produced by the U.S. Bureau of Economic Analysis. Using this data allows for comparisons of Canadian and U.S. trends extending back to 1961. We have compared Canada and United States estimates using data that we have constructed using more comparable definitions for a shorter time period, and have found that while levels are affected, the magnitude of relative growth rates reported here are not.

Estimates of the long-run share of manufacturing in GDP combine data from current estimates of GDP, at basic prices by industry, with industry estimates of GDP at factor cost. Historical data from 1926 to 1959 come from the Historical Statistics of Canada posted on Statistics Canada's website. Data prior to 1926 come from Urquhart (1993).

Data for capacity utilization in the United States are used as a measure of global industrial demand for Canadian products and are taken from the U.S. Federal Reserve Board. (see Section 6.) To provide the time series that extends from 1961 to 2007, we use the U.S. Standard Industry Classification (SIC)-based Manufacturing Capacity Utilization index. At the level of total manufacturing, the SIC and North American Industry Classification system (NAICS) schemes are essentially the same, making comparisons with other data sources at that level acceptable.

The data on the volume of GDP, labour inputs and capital services for individual manufacturing industries used in Sections 7 and 8 are taken from the Capital, Labour, Energy, Materials and Services (KLEMS) dataset, which is maintained by Statistics Canada's Productivity Accounts. The volume index of GDP is measured using a Fisher chained index based on value added calculated using double deflation techniques. Labour inputs are calculated by weighting hours worked using relative wage rates across workers–in order to adjust for experience and education levels across different classes of workers (see Gu et al, 2001, Baldwin, Gu and Yan, 2007). Capital services are calculated as the weighted average of asset-specific capital stocks using

Jorgenson's user cost of capital approach, in order to adjust for differential services provided by different assets (Harchaoui and Tarkhani, 2002 Baldwin, Gu and Yan, 2007). Changes in assets with a higher user cost (those with higher depreciation rates) contribute relatively more to growth in capital services.

Also employed is a longitudinal research file maintained by the Microeconomics Analysis Division, Statistics Canada, which is derived from the Annual Survey of Manufacturers (ASM). It provides a longitudinal data file for the period between 1961 and 2005. This file contains information on a range of firm characteristics including number of plants, number of employees, value of shipments, value added and diversification of plants and concentration of industries.

4 Canada in an international context

4.1 Manufacturing share of output

Examinations of share changes, even those of the long-run, rarely use data that extend beyond the early 1960s. International studies often use shorter sample spans to increase the number of countries for analysis; however, shares of manufacturing (or any industry for that matter) change slowly over time. Before we begin examining the modern data, it is useful to look at the share of manufacturing in Canada over a much longer time span and thereby place the present period in context.

The share of manufacturing output in Canadian GDP has been in decline since 1944, though it should be noted that this is a decline from levels that were themselves unusually high after the industrial mobilization that accompanied the Second World War (Chart 1). Between 1939 and 1943, the share of manufacturing increased dramatically as resources were transferred to the war effort. The immediate post-war economy made use of this increased capacity to satisfy consumer needs that had been postponed during the war and the new requirements that were associated with the population boom that followed.

That the decline occurred from supra-normal levels suggests that at least part of the decline after 1961 is simply a return to a more normal manufacturing share, but its continuation raises the question: can a retreat from untenable heights be equated to deindustrialization?

Canada is not the only country to experience a decline after 1961. The share of manufacturing value added[4] in aggregate GDP declined across a wide range of industrialized nations (Chart 2), regardless of whether they were relatively open or relatively closed economies, or whether they were resource importers or exporters. While the process is not smooth and exhibits periods of slow declines, rapid declines and sometimes temporary increases, the general trend was downward. This suggests that the evolutionary processes at work across many industrialized countries were remarkably similar.

4. GDP and value-added are synonyms for the income earned by factors employed in an industry to transform materials and service inputs into outputs.

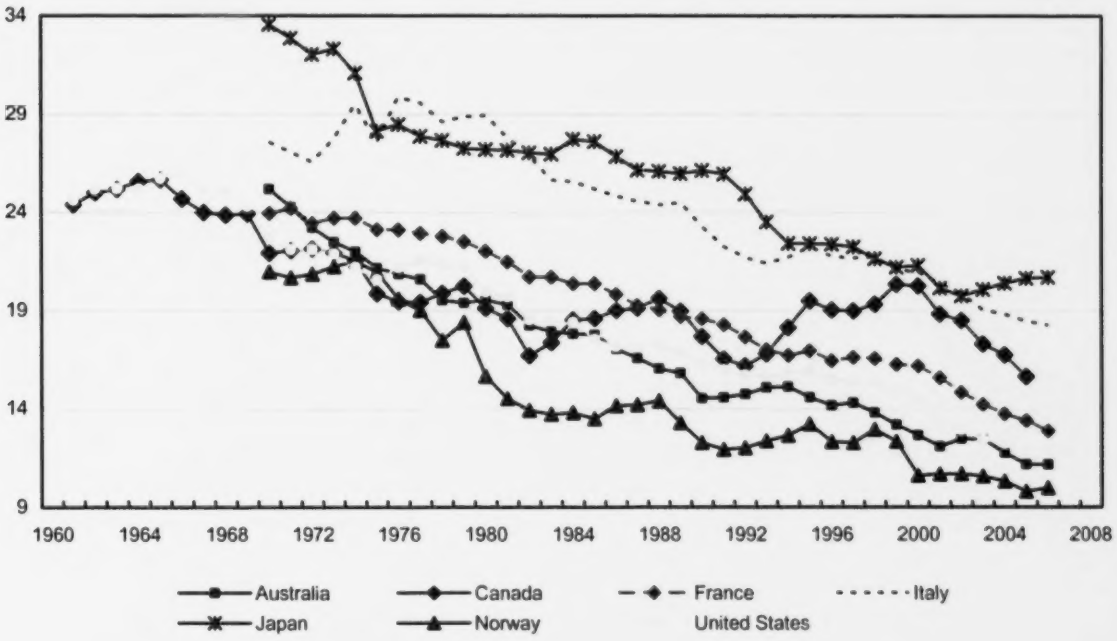
Chart 1
Manufacturing's share of gross domestic product, 1900 to 2005

Manufacturing share of nominal gross domestic product (percent)

Note: The manufacturing share is based on author's splicing of historical and modern series.
Source: Statistics Canada.

Chart 2
Manufacturing share of gross domestic product, 1961 to 2007

Share of value added (percent)



Source: Statistics Canada, CANSIM table 383-0022; U.S. Bureau of Economic Analysis; Organisation for Economic Co-operation and Development, Stan Database.

There are some exceptions to this continuous downward trend. Australia, Italy, Canada and Norway all show multi-year periods where manufacturing's share increases. In the case of all but Canada, the respite is relatively short-lived. In Canada's case, however, manufacturing's share is steady and actually rises slightly during the 20-year period from 1980 to 2000.

Despite this anomalous behaviour during the 1980s and 1990s, Canada's share of value added in manufacturing trended downward since the end of the Second World War. Between 1961 and 2005, the period spanned by the modern national accounts, the value added share of Canadian manufacturing declined by 8.7 percentage points, down from 24.3% to 15.6%. In contrast, the share of manufacturing in U.S. GDP declined by 12.6 percentage points, from 24.6% to 12.0%, for the same period. The percentage point decline in the United States was about 50% larger than Canada's. The difference is accounted for by the long hiatus during the 1980s and 1990s, when Canada's manufacturing share temporarily ceased to decline.

Between 1961 and 1980, the earlier part of the 45-year period, Canada and the United States experienced similar declines (Table 1); however, the two economies diverged in the 1980s and 1990s. During the 20-year period spanning 1980 to 2000, Canada's share of manufacturing in GDP rose slightly. In contrast, in the United States, the decline accelerated. After 2000, when Canada experienced a resource boom because of high commodity prices (Macdonald, 2008a, b), Canada's share of manufacturing declined more rapidly than other nations.

Table 1
Manufacturing share changes over time

Country	1961 to 1980	1970 to 1980	1980 to 2000	2000 to 2005
		percentage points		
Canada	-5.3	-2.8	1.2	-4.6
United States	-4.6	-2.7	-5.4	-2.6
France	..	-1.9	-5.8	-2.8
Italy	..	1.4	-8.0	-2.5
Japan	..	-6.4	-5.9	-0.7
Norway	..	-5.3	-5.0	-0.8
Australia	..	-5.6	-6.9	-1.5

Source: Statistics Canada.

4.2 Relative prices vs. relative volumes

Changes in manufacturing share of GDP can come from changes in either relative prices or relative volumes:

$$\Delta M_{Share,t/t-1} = \frac{P_{Manu,t} \times Q_{Manu,t}}{P_{GDP,t} \times Q_{GDP,t}} - \frac{P_{Manu,t-1} \times Q_{Manu,t-1}}{P_{GDP,t-1} \times Q_{GDP,t-1}}$$

$$= \left(\frac{P_{Manu,t}/P_{GDP,t}}{P_{Manu,t-1}/P_{GDP,t-1}} - \frac{Q_{Manu,t-1}/Q_{GDP,t-1}}{Q_{Manu,t}/Q_{GDP,t}} \right) \times \frac{P_{Manu,t-1} \times Q_{Manu,t}}{P_{GDP,t-1} \times Q_{GDP,t}}$$

$$= \left(\underbrace{\frac{P_{Manu,t}/P_{GDP,t}}{P_{Manu,t-1}/P_{GDP,t-1}}}_{\text{Relative Price Effect}} \times \underbrace{\frac{Q_{Manu,t}/Q_{GDP,t}}{Q_{Manu,t-1}/Q_{GDP,t-1}}}_{\text{Relative Volume Effect}} - 1 \right) \times \frac{P_{Manu,t-1} \times Q_{Manu,t-1}}{P_{GDP,t-1} \times Q_{GDP,t-1}}$$

$$= M_{Share,t-1} \times \left(\Delta P_{Manu/GDP,t/t-1} \times \Delta Q_{Manu/GDP,t/t-1} - 1 \right)$$

If relative price and relative volume changes exactly offset each other so that

$\Delta P_{Manu/GDP,t/t-1} = 1/\Delta Q_{Manu/GDP,t/t-1}$, there will be no change in manufacturing value-added shares over time. This will occur when relative price growth is positive (or negative) and relative volume growth is negative (or positive), but both are of the same magnitude. Manufacturing shares will rise (or fall) when an increase (or decrease) in relative prices or volumes is not offset by an accompanying change in the remaining relative measure.

Understanding whether it is a decline in prices or a decline in volumes is critical to any debate about deindustrialization. To investigate this issue, we calculate relative price and relative volume changes across countries (Table 2).

When average annual changes in relative price and volume are compared, relative price changes emerge as the primary source for declines in manufacturing GDP shares in Canada and the United States (Table 2). The share of manufacturing GDP in total GDP fell, primarily because relative manufacturing prices declined, not because relatively fewer manufacturing goods were being produced.

For Canada, the volume of manufacturing output relative to the total economy between 1962 and 2005 were essentially unchanged. On the other hand, relative prices fell by an average of 0.9% per annum, making them the primary source behind the declines in Canada's manufacturing share of GDP. A similar pattern exists in the United States where relative volumes rose at an average annual rate of 0.2% while relative prices declined by an average of 1.7%.

While there are some shorter time periods when relative manufacturing volumes did decline, the decline in relative prices during these periods was usually considerably greater than the volume changes. When relative volumes are considered, there is little persuasive evidence that manufacturing was in a long-run decline.

Table 2
Average relative price and volume changes by period

	1962 to 2005	1971 to 2005	1962 to 1970	1971 to 1980	1980 to 1990	1990 to 2000	2000 to 2005
				percent			
Canada							
Relative price	-0.9	-0.7	-1.8	-1.2	-0.3	-0.1	-3.0
Relative volume	0.0	-0.2	0.7	-0.1	-1.0	0.8	-1.1
United States							
Relative price	-1.7	-1.8	-1.4	-1.1	-1.6	-2.2	-2.8
Relative volume	0.2	0.1	0.5	-0.1	-0.7	0.8	-0.7
France							
Relative price	..	-1.0	..	-0.3	0.0	-1.2	-2.9
Relative volume	..	-0.7	..	-0.5	-1.7	-0.1	-0.2
Italy							
Relative price	..	-1.5	..	-1.8	-2.0	-1.2	-0.9
Relative volume	..	0.4	..	2.4	0.1	-0.2	-1.3
Japan							
Relative price	..	-1.3	..	-1.5	-0.8	-1.3	-1.3
Relative volume	..	-0.1	..	-0.5	0.5	-0.4	0.9
Norway							
Relative price	..	0.4	..	0.4	-0.1	0.7	-3.5
Relative volume	..	-2.4	..	-3.1	-3.3	-2.5	-0.2
Australia							
Relative price	..	..	..	..	..	-0.1	-0.8
Relative volume	..	..	..	..	..	-1.8	-1.9

Source: Statistics Canada.

This is not the case for countries other than Canada and the United States (see Appendix 1). France, Norway and Japan experienced long-run declines in their volume of manufacturing, relative to total economic output; however, with the exception of Norway, the decline in prices is a more important determinant of the decline in the share of manufacturing.

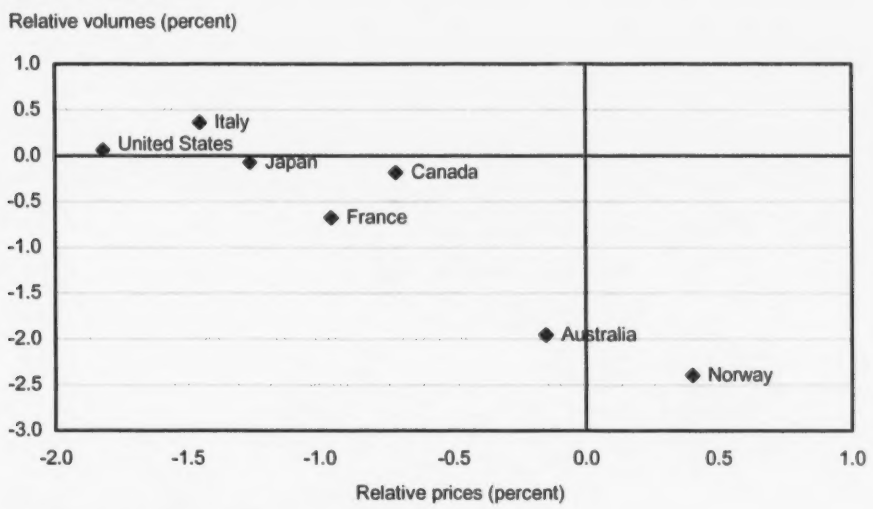
4.3 Relative elasticities

For this group of countries, relative price changes are negatively related to relative volume movements (Chart 3). As manufacturing prices decline relative to the overall price level, relative demand for manufactured products increases. In countries where the relative price of manufactured goods tends to rise, the relative volume of manufactured goods tends to fall.

Importantly, the same basic pattern between price and volume changes emerges regardless of trade openness. With the exception of Norway, long-run changes in the relative share of manufacturing are the result of relative price changes not being offset by relative volume changes.

While the relative demand for manufactured goods increases in response to price declines, the increase is not sufficient to offset the relative price decline: and so the relative value of manufacturing output fell steadily over the time period studied. The pattern of relative price changes and relative volume changes suggests that either the cross price elasticity between goods is small or the income effect favours services over the consumption of goods. Both situations lead to demand for manufacturing products not adjusting one-for-one to changes in relative prices, and gives rise, across industrialized countries, to the declining share of manufacturing in value added.

Chart 3
Average annual changes in relative prices and relative volumes, 1971 to 2005



Note: Data for Australia span from 1990 to 2005.
Source: Statistics Canada.

4.4 Relative price decline and productivity

The decline in the relative price of manufacturing goods is a long-run phenomenon that has been generated by technological differences that, in turn, led to greater productivity growth in goods-producing industries in general and manufacturing industries in particular. Between 1961 and 2005, Canadian labour productivity growth in the goods industries averaged 2.3% per year, but only 1.4% per year in the service industries.

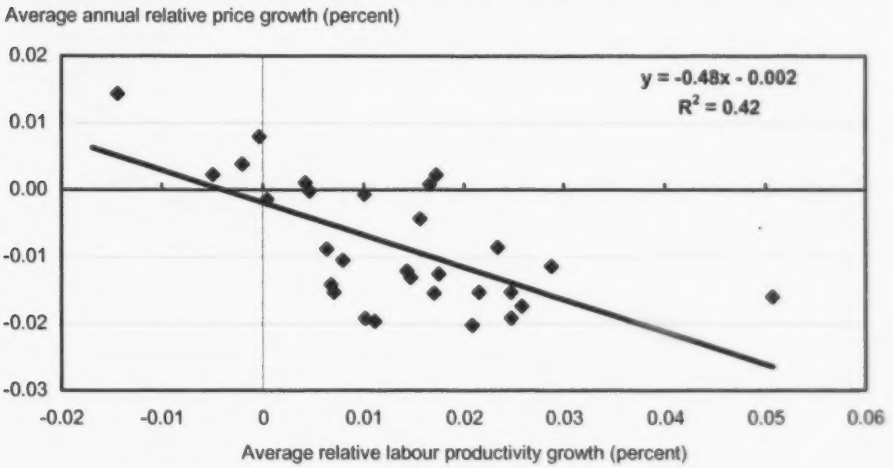
Competitive markets tend to pass productivity improvements on to consumers via lower prices. In a world where there is general inflation, prices tend to go up less in industries with higher productivity growth.[5] The difference between the manufacturing sector and the rest of the economy with respect to productivity growth rates is the driver of the long-run difference between relative price movement of the goods produced by the manufacturing sector and the rest of the economy.

As confirmation that this phenomenon is also present generally across the countries for which we have data on manufacturing shares, a regression was run of relative price change on relative productivity for a set of countries and time periods that provided matching data. Labour productivity was used, though total or multifactor productivity would have been a preferable measure for this purpose, but is not available.[6]

The estimated relationship is:

$$\Delta {}^{P_{Manu,t}}\!/_{P_{GDP,t}} = \alpha + \beta \Delta {}^{LP_{Manu,t}}\!/_{LP_{GDP,t}} + \varepsilon_t$$

Chart 4
Relationship between the relative price change and productivity



Note: Pooled data for the periods from 1981 to 1990 and from 1991 to 2001 where data on relative labour productivity and relative prices for countries coincide.
Source: Statistics Canada.

5. See Baldwin, Durand, and Hosein (2001) for Canadian evidence.
6. See Kaci, and Maynard (2002) for a discussion of the use of alternate productivity measures for measuring the impact of productivity on different measures of unit costs. Labour productivity is useful for measuring unit labour costs: total factor productivity takes into account all factor costs. But as Salter (1960) pointed out, empirically, various measures of productivity tend to be closely related.

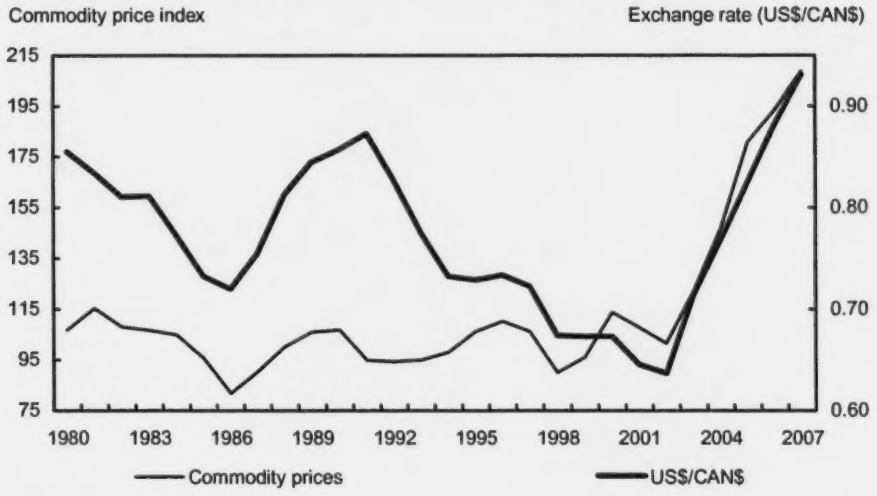
Manufacturing prices have the greatest decline where relative productivity in the manufacturing sector grows fastest. The elasticity estimate for changes in relative prices with respect to changes in labour productivity is -0.48. Each percentage point increase in relative labour productivity growth leads to roughly a half a percentage point decrease in relative price growth.

5 Relative prices and the dollar

While manufacturing prices are influenced by the course of technological change, other events also influence the trend in prices. One such event in Canada came from an exchange-rate shock that served to dampen the downward pressure on manufacturing prices throughout the 1980s and 1990s, thus reducing the downward movement on manufacturing's share of GDP.

The Canadian economy's strong resource base in metals, oil and gas and forestry is subject to commodity price cycles. These cycles are associated with fluctuations in the dollar, as Chart 5 demonstrates.

Chart 5
Canada/U.S. exchange rate and commodity price index



Source: Statistics Canada.

The manufacturing sector, (located primarily in central Canada), serves both a domestic market and an export market primarily to the United States. The manufacturing sector competes in a North American market and its prices are determined by both domestic Canadian costs and U.S. prices (Kardaz and Stollery, 1988; Baldwin and Yan, 2008). The influence of U.S. markets increases during periods when the Canadian dollar appreciates and decreases when it depreciates (Baldwin and Yan, 2007).

The long-term depreciation in the Canadian dollar starting in the late 1970s (Chart 6) produced a period of respite from competition with the United States, which was accompanied by a slowdown in the decline in the relative prices of manufactures to other goods.

Baldwin and Yan (2007) investigate the responsiveness of Canadian manufacturing prices to domestic inflation and to U.S prices over this period and find that the importance of U.S prices

declined during these periods of exchange-rate depreciation (1974 to 1986, 1991 to 1996). A depreciating Canadian dollar gives Canadian industries a relative cost advantage (or reduces their disadvantage), which provides room for home producers to adjust their prices more to cost conditions at home and less to movements in U.S. prices. The appreciation of the Canadian dollar between 1986 and 1991 made products from the United States relatively less expensive than domestic products, and Canadian manufacturing prices became much more sensitive to U.S. price changes at this time.

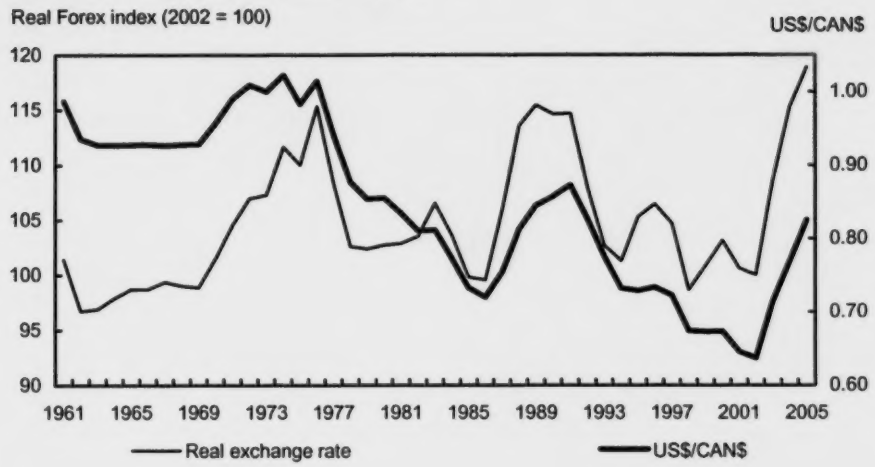
Chart 6
Canadian relative prices of manufactured goods and the Canadian/U.S. exchange rate

Note: GDP: gross domestic product.
Source: Statistics Canada.

The degree to which the long-run depreciation of the Canadian dollar provided a respite for the manufacturing sector depends on how Canadian and U.S. prices move relative to one another. This can be gauged by movements in the real exchange rate, the ratio of the relative price of Canadian to U.S manufacturing goods, divided by the exchange rate (Chart 7).

When the real exchange rate maintains its value, relative prices and the exchange rate are mutually adjusting so that movements in the relative prices of goods in the two countries are offset by changes in the exchange rate. No changes in competitive pressures from international trade are placed on either market by changes in the real exchange rate; that is to say that relative prices of imports or exports to domestically produced goods are unchanged. If the real exchange rate should change, then pressures are either intensified or dissipated. For example, a depreciation of the Canadian dollar by itself makes U.S. imports more expensive in Canada and—all things being equal—relaxes competitive pressures to pass on productivity improvements to Canadian consumers. An appreciation of the Canadian dollar has the opposite effect. Use of the real exchange rate, rather than the nominal exchange rate, takes into account inflation and other factors that are at work each year changing the relative prices between the two countries.

Chart 7
Manufacturing real exchange rate



Source: Statistics Canada.

Both the nominal and real exchange rates for manufacturing goods have followed similar cycles (Chart 7). The Canadian dollar appreciated following Canada's exit from Bretton Woods and then began a long period of depreciation that lasted until the 1990s. During this period, however, the real exchange rate for manufacturing goods that had been increasing, (putting the Canadian manufacturing sector under pressure), declined as the depreciation of the dollar occurred, and did not increase until the dollar appreciated in the late 1980s. The next round of depreciation in the 1990s returned the real exchange rate to its level of the 1970s and 1980s.

It is during this period that the relative price of manufacturing products levelled out or rose modestly, and Canada experienced a hiatus from its trend decline in manufacturing's share of GDP.

An alternative way to see the impact on the Canadian manufacturing sector of the long period of depreciation is to compare the course of U.S. and Canadian manufacturing prices over time—along with the exchange-rate corrected Canadian price (Chart 8).[7]

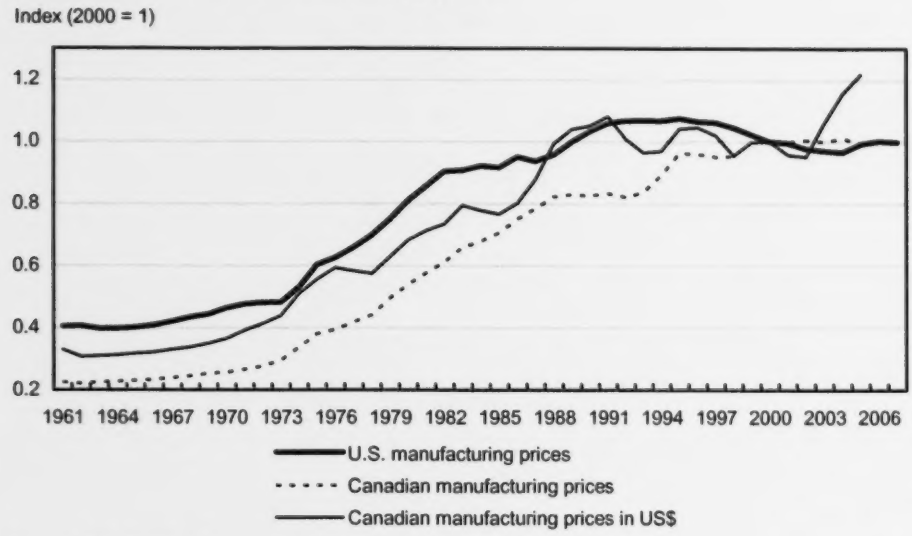
Canadian prices corrected for exchange-rate movements increased relative to U.S. prices, from the early 1960s to the mid 1970s. With the depreciation of the Canadian dollar after 1976, there was a return to the relationship between the two countries enjoyed in the early 1960s. This state of affairs continued until the Canadian dollar began to appreciate in the late 1980s, at which time Canadian manufacturing's relative competitiveness declined markedly, only to be partly restored when the Canadian dollar depreciated in the 1990s. After 2000 the appreciation of the Canadian dollar generated an unprecedented departure of Canadian manufacturing prices expressed in US$ from those of the U.S.

All this emphasizes first, the general problem of interpreting movements in the manufacturing's share of value added to infer that the industry is successfully maintaining production levels and

7. By adjusting the Canadian manufacturing price for the dollar, we assume that currency fluctuations are felt broadly across manufacturers in a consistent manner over time.

second, the need to investigate the underlying causes of both volume and price changes. Prices are an important determinant of the share of value added. Prices, as we have seen, can deviate from their long-term trajectory in a small, open economy like Canada's because of exchange-rate cycles. During the 1980s, Canadian manufacturing prices deviated from that trend as the exchange-rate depreciation reduced the amount of pressure coming from international competition.[8] The resulting upward deviation helped to create a short-term hiatus from the longer downward trend in Canada's share of GDP originating in the manufacturing sector.

Chart 8
Canadian and U.S. manufacturing prices



Source: Statistics Canada.

6 Canada's link to the United States

The Canadian manufacturing sector has been affected by economic shocks emanating from the United States. These shocks lead to changes in demand for Canadian manufacturing products and affect the performance of manufacturing relative to the overall economy. As a general rule, when manufacturing in the United States performs relatively well, manufacturing in Canada does well and vice versa.

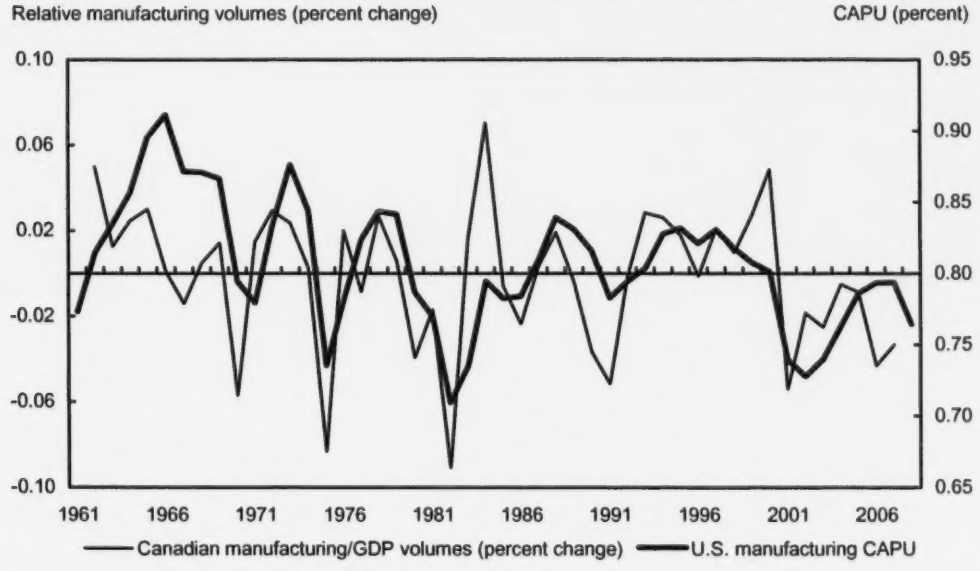
The close link between Canadian performance and the U.S. business cycle can be illustrated by tracking annual changes in the relative volume of Canadian manufacturing against the U.S. Federal Reserve Manufacturing Capacity Utilization (CAPU) Rate Index (Chart 9). This index provides a measure of business capacity that is devoid of a trend, making it ideal for a comparison to relative growth calculations. During periods of economic expansion, when demand for manufacturing products is robust, the index moves above its long-run average. When demand for manufactured products is weaker, during recessions or resource booms, the index falls below its long-run average.

8. It should also be noted that the 1980s also marked a time period when Canada's growth in labour productivity fell behind that of the United States (Baldwin and Gu, 2007).

In Canada and the United States, manufacturing is more cyclical than the overall economy. During periods of expansion, manufacturing grows faster than total value added; during slowdowns, it grows less rapidly than the overall economy or it tends to contract more. The question is whether or not Canadian manufacturing responds to the same forces as does the manufacturing sector in the United States. If it does, then there should be a positive relationship between changes in the relative growth of manufacturing in Canada and manufacturing capacity utilization in the United States.

Between 1961 and 2007, Canada's manufacturing volume responded closely to changes in United States capacity (Chart 9). During periods when U.S. CAPU was above its long-run average of 81%, Canadian manufacturing volumes rose faster than overall GDP. When U.S. CAPU dropped below its long-run average, Canadian manufacturing volumes declined relative to overall GDP. During the 1973 and 1979 oil shocks and the recessions of 1975-1976, 1980, 1981-1982, 1991 and 2001, manufacturing volumes in Canada declined relative to total GDP volume. Although a relative decline is often accompanied by an absolute decline in the volume of GDP in manufacturing, manufacturing volumes do not necessarily have to shrink to generate a relative decline. A slowdown in manufacturing growth is sufficient to generate a relative decrease. During the post-2001 period, when U.S. CAPU was below average and manufacturing in Canada went through a restructuring (Macdonald 2008, a. b), volumes rose modestly, although the sector declined in relative terms.

Chart 9
Relative Canadian volume changes and U.S. manufacturing capacity utilization

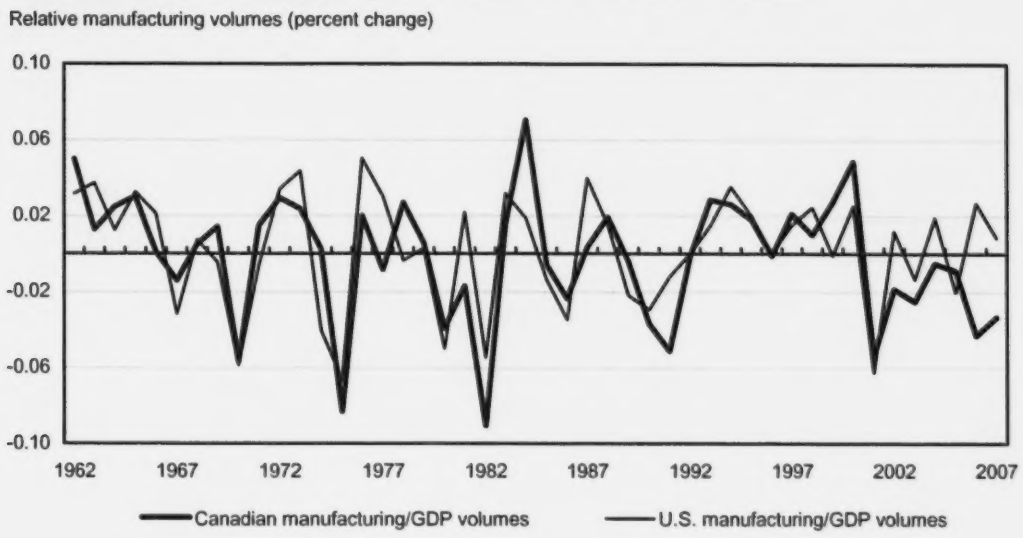


Notes: CAPU: capacity utilization; GDP: gross domestic product.
Source: Statistics Canada.

The relative volatility of the two economies' manufacturing sectors is compared in Chart 10. During the 1975/1976, 1981 and 1991 recessions, Canada's manufacturing relative decline was larger than that of the United States. Following the 1981 recession, Canada's recovery saw a relative increase in manufacturing volume growth (about twice as large as the relative gains posted in the United States).

Over the entire period from 1961 to 2007, the standard deviation of Canadian relative growth rates was about 10% higher than that of the United States. Canada's relative performance, however, was very different in the first half and the last half of the period. During the first half of the period, Canada was more stable than the U.S. (standard errors of 3.2% and 3.6% respectively). In the second half, Canada's performance became more volatile than that of the United States (3.5% and 2.7%, respectively).

Chart 10
Manufacturing volume changes in Canada and the United States



Note: GDP: gross domestic product.
Source: Statistics Canada.

7 Trade liberalization, compositional shifts and productivity performance

Exchange-rate cycles and business cycles are not the only factors affecting the long-run health of the manufacturing sector. Industrial strategies designed to increase the competitiveness of Canadian manufacturing plants through trade liberalization were implemented throughout the 1961-2005 period.

Reductions in tariffs have also been accompanied by dramatic declines in transportation costs as a result of technological progress in equipment and improvements in transportation command and control systems. This has led to an increased integration between Canada and the United States and opened up larger markets for Canadian producers.

It was predicted that the impact of free trade would be beneficial to those industries where access to larger markets would reduce costs because of the exploitation of either scale or scope economies. Larger markets did lead to rationalization within industries: less productive plants were closed and more productive plants were opened (Treffler, 2004; Baldwin and Gu, 2006; Lileeva, 2008). Plants also rationalized product lines by reducing the number of products and

increasing the length of production runs (Baldwin, Beckstead and Caves, 2002; Baldwin, Caves and Gu, 2005).

Freer trade has had a dramatic impact on the makeup of the manufacturing industry: durable goods industries expanded their shares, while the share of non-durables contracted. By 2005, the composition of the manufacturing sector was considerably different from 1961, with most of the change occurring after the implementation of NAFTA.

Durable industries consist of transportation equipment, primary metals, non-metallic minerals, fabricated metals, machinery, wood products, computer and electronic products and electrical equipment. Non-durables include food, beverages, tobacco, clothing, textiles, leather, paper, petroleum, chemicals and plastic products.

Durable goods industries differ from non-durables in a number of respects (Table 3). First, durables had exported more intensely before NAFTA. Export intensity of the average plant was at least 50% higher in durable than non-durable industries. Durables were already in export markets and benefited from additional access to North American markets. For durable goods industries, economies of scale were more important: these were industries where the ratio of the minimum efficient plant size was large relative to industry size.[9] Durable industries also had both higher production worker and non-production worker wages. Industries with higher wages tend to have higher skill levels and to invest more in workers. This investment is a fixed cost that must be spread across larger volumes of products. Durable goods industries also had larger value added per worker—a measure of both capital intensity and wage rates. Finally, the average length of production run was larger—a measure of the extent of product-run scale economies. These were the characteristics that economists (Harris, 1985 Antweiler and Trefler, 2002) predicted would determine which industries were likely to benefit most from trade liberalization. Interestingly, both average plant size and value added differentials between durables and non-durables get larger after NAFTA, thereby suggesting that the agreement favoured the development of larger plant sizes and improvements in productivity in the durables good sector.

Table 3
Industry characteristics – durables over non-durables

	1990	1999
	ratio	
Export intensity – exports over sales	1.731	1.562
Minimum efficient size as percent of total industry size	1.220	1.243
Average plant size – production workers	0.972	1.008
Annual salary per non production worker	1.051	1.098
Manufacturing value added per production worker	0.789	1.111
Length of production run – sales	1.017	1.347
Annual wage rate of production workers	1.098	1.155

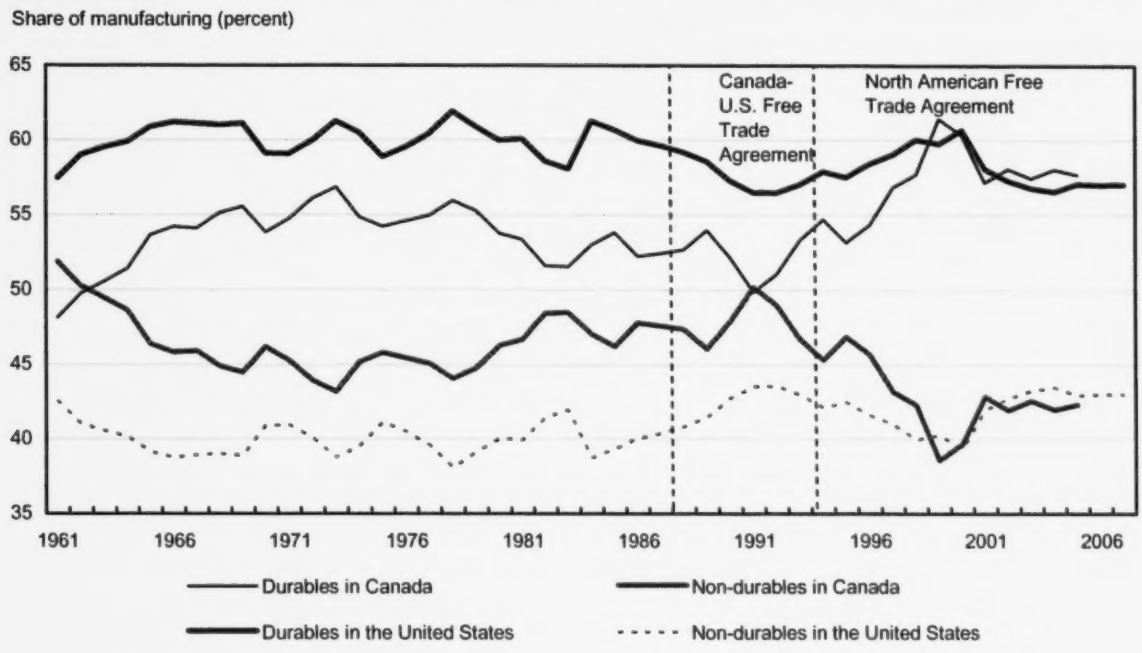
Note: Tobacco is excluded from non-durables category.
Source: Authors' calculations from Annual Census of Manufactures.

Between 1961 and the early 1990s, the shares of durables and non-durables manufacturing in Canada and the United States tracked one another (Chart 11). The share of durables

9. The minimum efficient size plant (MES) is calculated as the average size of the largest plants that account for the top 50% of shipments. See Baldwin (1995) for a discussion of this measure.

manufacturing expanded in both the United States and Canada in the 1960s. During the 1970s and 1980s, both countries experienced a gradual decline in the share of manufacturing devoted to durable goods.

Chart 11
Durable and non-durable shares in manufacturing in Canada and the United States



Source: Statistics Canada.

Until the implementation of NAFTA, Canada's share of durables in manufacturing was lower than the U.S. share and the gap between the two was fairly constant for 30 years. By 1991, the relative shares of durables and non-durables were at the same level as they had been in 1962/1963.

Following the implementation of NAFTA, a transformation of the Canadian manufacturing industry began that culminated with the technology collapse in 2001. Over the seven years from 1994 to 2001, the structure of Canada's manufacturing industry was transformed until the shares in durables and non-durables matched those of the United States.[10] Share changes were pervasive, increasing across many durables industries and decreasing in nearly every non-durable industry (Table 4).

In some cases, particularly on the durables side, this growth was new. Non-metallic minerals, fabricated metal products, computers, furniture and miscellaneous manufacturing all showed increases in industry shares after 1994 that were not present during the 1980s. In wood products and transportation equipment, the 1990s saw a continuation of the upward trend in share that extended back to the late 1970s, and in the case of transportation equipment, the establishment of the Auto Pact (see Appendix 2 for Canada/U.S comparisons).

10. A similar change occurred in Mexico—see Appendix 3.

Table 4
Shares in manufacturing value added

Industry	1961	1970	1980	1990	2000	2005
			percent			
Food	12.0	10.8	10.1	11.2	8.6	10.5
Beverage and tobacco product	4.9	4.6	3.5	3.7	2.9	3.8
Textile and textile product mills	2.5	2.3	2.0	1.9	1.5	1.3
Clothing	4.4	4.0	3.5	2.9	2.3	1.5
Leather and allied product	1.5	1.1	0.9	0.5	0.3	0.1
Paper	10.7	9.0	10.5	8.2	7.7	5.8
Printing and related support activities	2.7	2.5	2.7	3.9	3.0	3.2
Petroleum and coal products	2.9	1.5	2.1	1.3	1.4	2.5
Chemical manufacturing	8.2	7.6	7.9	10.3	7.2	7.9
Plastics and rubber products	2.2	2.8	3.1	4.1	4.9	5.7
Wood product manufacturing	4.4	4.2	5.8	4.1	6.5	6.7
Non-metallic mineral product	3.7	3.6	3.4	3.3	2.5	3.2
Primary metal manufacturing	8.9	9.0	8.8	6.3	6.2	6.9
Fabricated metal product	6.6	7.7	7.3	6.4	7.4	7.9
Machinery	4.3	5.4	7.1	5.9	6.6	7.1
Computer and electronic product	4.5	5.3	4.7	5.0	6.2	3.9
Electrical equipment, appliance and component	4.2	4.3	4.0	3.4	2.4	2.0
Transportation equipment	7.9	10.6	9.2	13.3	17.7	14.3
Furniture and related product	1.7	1.8	1.8	2.7	3.0	3.4
Miscellaneous	1.8	1.9	1.8	1.7	1.8	2.3
Non-durables	51.9	46.2	46.2	47.9	39.7	42.3
Durables	48.1	53.8	53.8	52.1	60.3	57.7

Source: Statistics Canada.

On the non-durables side, industries like textiles, apparel and leather continued the ongoing declines in their share of manufacturing—as they did the United States. The chemical product manufacturing industry in Canada saw a more rapid decrease in its share than had previously occurred—contrary to the U.S. experience.

Following the 2001 technology collapse, the shares of durables and non-durables in Canada continued to match those of the United States. NAFTA brought about a transition in Canada's manufacturing industry that did not dissipate with either the 2001 recession or during the resource boom that followed.

Productivity measures the efficiency with which industries transform inputs into outputs. Those industries with higher productivity performance can afford to pay workers higher wages without becoming unprofitable and can absorb greater price competition from abroad. Industries that fall behind, in terms of productivity performance, find themselves in increasing difficulty in labour markets and with regards to foreign competition, even when there are no major exchange-rate shocks or changes in trade regimes.

In light of the success of the durables sector, it is not surprising to find that productivity performance in durables was superior to the productivity performance in the non-durables sector over most of the period (Table 5). This was true for the partial productivity measures—labour productivity and capital productivity—and for the more comprehensive measure of multifactor productivity that provides a weighted average of the two partial productivity measures.

Table 5
Productivity performance of durables and non-durables

	1962 to 2007	1962 to 1970	1971 to 1980	1981 to 1990	1991 to 2000	2001 to 2007
			percent			
Multifactor productivity						
Non-durables	1.2	1.5	2.2	0.4	1.7	-0.3
Durables	2.2	2.7	2.2	1.9	3.1	0.3
Labour productivity						
Non-durables	2.6	3.2	3.7	2.1	2.8	0.9
Durables	3.3	4.2	3.0	3.0	4.3	1.3
Capital productivity						
Non-durables	0.2	-0.1	1.0	-1.0	1.3	-0.7
Durables	1.0	1.4	1.2	0.5	1.9	-0.5

Source: Statistics Canada.

8 Long-run growth

The previous sections have focused on the movement in the relative share of the value of total output accounted for by the manufacturing sector. While the relative share fell, this was primarily the result of lower relative prices. The change in the trajectory of relative prices that occurred in the late 1970s/early 1980s is primarily responsible for reducing downward pressure on manufacturing's share of nominal GDP.

Over the past half century, the Canadian manufacturing sector has adapted to business cycles, exchange-rate movements, and increasing trade liberalization which have affected both its relative competitiveness and its structure.

As has been emphasized in previous sections, diminishing output share does not necessarily imply a diminution in the volume of output. Between 1961 and 2005, the relative volume was approximately constant, while the relative price of manufactures declined (Table 6). This can be represented graphically when the share of manufacturing in the value of GDP is compared with relative volume and relative price indexes (Chart 12). The comparison clearly illustrates the dominant role of relative prices and the impact of business cycles on the share of manufacturing in GDP.

More important, over the time period, the actual volume of goods produced (the volume index of GDP in manufacturing) increased. The rate of increase was also positive in the 1990s following NAFTA's implementation. During this time, growth was positive in non-durables (the sector that saw its share diminish), and in durables, whose share increased. In the years after the technology bubble burst in 2001, manufacturing growth averaged 0.4% per annum between 2002 and 2007.

In Canada, the transition under NAFTA resulted in above-average growth in the volume of GDP produced in almost all manufacturing industries between 1994 and 2000 (Table 6). The exceptions were beverage and tobacco products, petroleum and coal products, and chemical manufacturing. The compositional shift towards durables resulted from a larger expansion of durables than non-durables.

Table 6
GDP volume, labour input and capital services long-run growth vs 1994-2000

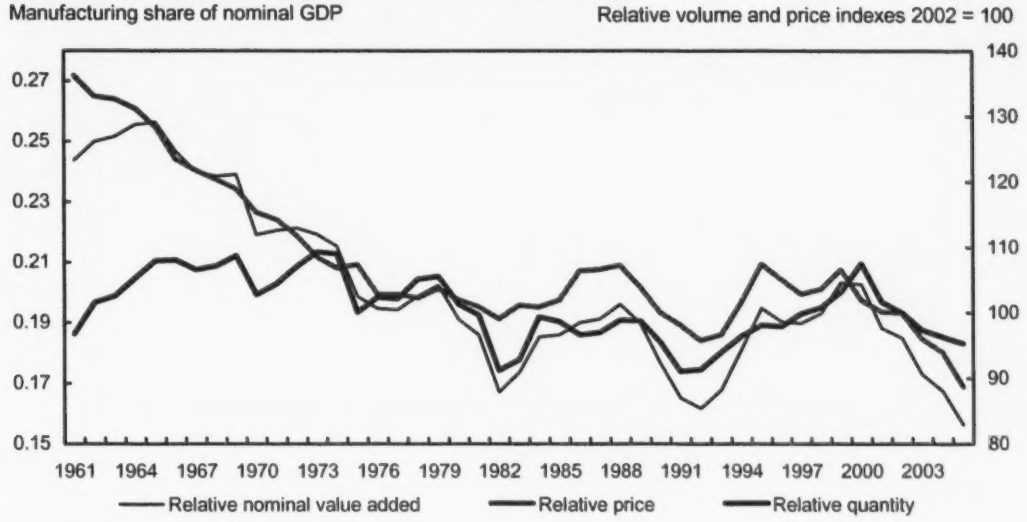
	Gross domestic product volume growth			Labour input growth		Capital services growth	
Industry	1962-to-2005 average	1994-to-2000 average	2001-to-2007 average	1962-to-2005 average	1994-to-2000 average	1962-to-2005 average	1994-to-2000 average
				percent			
Food	2.3	2.3	2.3	0.5	0.8	2.5	1.8
Beverage and tobacco product	1.4	0.5	-3.8	-0.4	-3.6	0.8	-1.9
Textile and textile product mills	2.7	5.1	-6.7	0.0	1.7	1.2	1.7
Clothing	1.0	4.8	-8.5	-0.8	1.7	0.7	2.3
Leather and allied product	-2.1	0.2	-11.0	-3.7	-3.5	0.1	1.5
Paper	2.5	2.9	0.7	0.9	0.1	2.1	-1.9
Printing and related support activities	2.3	2.4	-1.9	2.0	2.9	3.7	2.8
Petroleum and coal products	4.4	2.6	-1.4	1.5	1.2	2.8	-0.7
Chemical	4.9	4.5	1.4	1.3	-1.1	3.6	3.4
Plastics and rubber products	6.9	8.6	1.7	4.0	6.1	5.2	5.1
Wood product	4.5	6.7	1.0	1.4	4.0	3.7	7.8
Non-metallic mineral product	3.1	5.7	3.2	0.8	2.7	1.3	2.2
Primary metal	3.3	4.5	1.3	0.3	1.3	1.9	0.9
Fabricated metal product	3.9	11.1	0.2	2.4	7.9	2.3	4.9
Machinery	4.7	7.6	1.0	2.6	5.1	3.5	5.6
Computer and electronic product	7.7	17.0	-4.6	1.8	4.9	6.3	12.4
Electrical equipment, appliance and component	2.7	7.2	-3.9	0.4	1.6	2.4	4.2
Transportation equipment	6.7	7.7	0.0	2.3	2.3	4.9	6.2
Furniture and related product	5.0	11.8	-0.9	2.9	7.8	3.6	7.7
Miscellaneous	4.6	9.7	2.7	1.6	5.9	2.9	3.4

Note: Labour input and capital services growth consists of weighted average growth rates of workers across different experience and education levels and assets across different types. See Baldwin, Gu and Yan (2007) for further discussion.
Source: Statistics Canada.

After 2000, the shift towards durable goods production continued through the 2001 collapse of the technology sector and the subsequent resource boom. The pattern of expansion, however, changed. Durable goods volumes tended to increase while non-durable goods production declined. Between 2001 and 2007, the volume index of GDP expanded across most durables industries, with the exception of computer and electronic products, transportation equipment and furniture. Across most non-durables industries, the volume index declined.

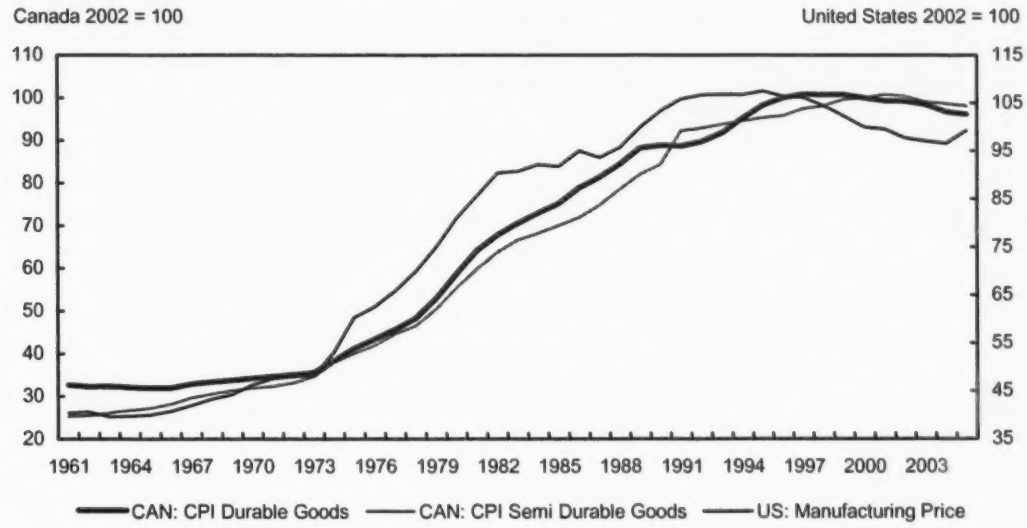
China's emergence as a manufacturing centre, combined with the resource boom, created the largest relative price shock to hit Canada since the oil shocks of the 1970s (Macdonald 2008a, b, Francis 2007, 2008). In Canada, the price of consumer durables (i.e., appliances) and semi-durables (i.e., clothing, footwear) began, for the first time in a half century, to trend downward, as did U.S. manufacturing prices (Chart 13). The strong international competition from China, combined with increased input costs associated with the commodity boom, placed new pressures on manufacturing industries. In general, industries producing consumer products tended to reduce economic activity while areas producing capital inputs, particularly those that are used as inputs into resource extraction, processing or transportation, tended to expand their output.

Chart 12
Manufacturing share of gross domestic product



Note: GDP: Gross domestic product.
Source: Statistics Canada.

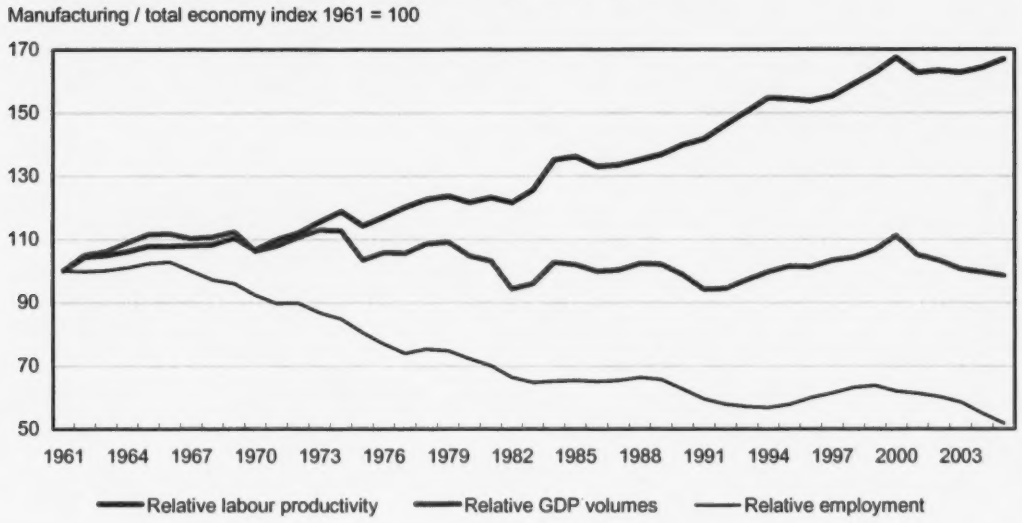
Chart 13
Price declines after 2000



Note: CPI: consumer price index.
Source: Statistics Canada.

Assessments of the health of manufacturing often focus on the state of inputs—especially labour demand. The rate of growth in inputs depends jointly on output growth and productivity growth. The lower the growth in output and the higher labour productivity growth, the lower the increase in the demand for labour will be. Since an identity links labour productivity to output and employment growth, as Chart 14 indicates, the decline in employment share was the result of a more or less constant share of output combined with a higher growth in relative productivity.

Chart 14
Relative employment, labour productivity and volumes



Note: GDP: gross domestic product.
Source: Statistics Canada.

Despite the decline in the relative share of total employment in manufacturing, the demand for inputs has grown in absolute terms. Over the half century examined, both labour and capital inputs have increased in almost all industries (Table 6).[11] The exceptions are employment in beverages, leather and clothing—three non-durable industries. Throughout the period, capital inputs have increased across all industries—even in those three non-durable consumer goods industries that have seen declines in labour input. More importantly, the growth of capital inputs has been greater than the growth in labour inputs. Capital-labour ratios have increased universally across all manufacturing industries. Over the period from 1961-2005, capital services increased over 2.5 times the rate of labour services.

Inputs for both durables and non-durables labour inputs have grown over the period since 1961 (Table 7). Between 1961 and 2007, non-durables labour input rose by 0.8% annually while durables labour input increased at an annual growth rate of 1.6%. Labour input increased in durables industries relative to non-durables.

Labour input change can be decomposed into two sources: first, changes in hours worked and second, the compositional changes in the labour force due to increased skill levels of a workforce with rising levels of experience and education. From 1961 to 2007, for durables goods industries, 34% of labour input growth came from compositional shifts and 66% of growth came from changes in hours worked. Labour input growth in non-durable industries is almost completely the result of compositional changes—that is, hours worked actually remained constant over the entire time period, but there was a compositional shift away from less educated workers, towards more educated workers.

11. These labour inputs consist of weighted average growth rates of workers across different experience and education classes. See data section for discussion.

Table 7
Growth in labour and capital inputs (annual)

	Labour input	Labour input by source		Labour input by education level		
		Hours worked	Compositional shift	Primary/ secondary	Some post-secondary	University degree
			percent			
Durables						
1962 to 2007	1.6	1.0	0.5	-0.7	7.8	5.0
1994 to 2000	4.2	3.7	0.5	1.2	6.2	7.8
2001 to 2007	-1.0	-1.5	0.5	-3.1	-0.6	2.4
Non-durables						
1962 to 2007	0.8	0.0	0.8	-1.3	7.4	4.4
1994 to 2000	1.3	0.7	0.6	-0.7	3.3	2.8
2001 to 2007	-0.3	-1.1	0.9	-3.0	0.5	3.7

Source: Statistics Canada.

The 1990s and the post-2000 period differ substantially in terms of the growth of labour inputs. In the former period, labour growth is positive both for durables and non-durables. In the post-2000 period, labour input growth is negative in both sectors. Most of this change occurs in hours worked. The increase from compositional change continues to be positive in both time periods.

Labour input can also be broken down by education level to assess the source of compositional change. Growth has been generally highest over the entire period in the group with some post-secondary education. Except for the period of the 1990s when growth in labour inputs was high, the growth in the demand for labour with only primary or secondary education levels has been negative. For durables, the growth in the demand for workers with a university degree has been positive over the period and its growth rate was higher than for those with post-secondary education in both the 1990s and the post-2000 period. The growth in the demand for university labour inputs was relatively less important in non-durables in the 1990s. In the period after 2000, however, demand for this group of workers has exceeded that of the post-secondary group, which nevertheless has still had a positive growth. The major declines, after 2000, are felt in the group with only primary or secondary education levels.

9 Conclusion

Talk of deindustrialization in Canada focuses on the decline of the manufacturing sector. Sometimes this dialogue focuses on the statistics showing that manufacturing accounts for less and less of the total output of the economy—that the share of the value of GDP accounted for by manufacturing has been falling.

While this trend occurred in Canada, it was also seen in many countries where the severity of the decline has been greater. The decline in share of the value of GDP accounted for by manufacturing, however, need not have been caused by a decline in the goods produced by manufacturing, since the value of GDP is made up of both a relative price and a relative volume component. Much of the decline in relative overall value derived from manufacturing comes not from relative volume declines, but from relative price declines, which are generated partly by superior productivity performance in manufacturing.

With respect to the share of GDP produced in manufacturing, Canada's relatively superior performance, compared to other OECD countries, stems primarily from a different trend in relative manufacturing prices. The downward trend in relative manufacturing prices in Canada tracked that of the United States in the 1960s and early 1970s, but then underwent a hiatus in the 1980s and 1990s. This period corresponds closely to events that led to a depreciation of the Canadian dollar against the U.S. dollar that reduced competitive pressures on Canadian manufacturers. The superior Canadian performance (using the GDP share metric) occurred primarily as a result of these unique movements in manufacturing relative prices (compared to other countries).

Nevertheless, the value of Canadian manufacturing output did not decline relative to other sectors. It held its own in terms of relative volumes during the last half century. In absolute terms, the volume of manufacturing output has increased over the period.

This progress has been subject to substantial cycles over time as a result of different events. Business cycles in the United States affect the Canadian manufacturing sector directly. Exchange-rate and commodity cycles are indirectly associated with changes in competitive pressures faced by Canadian manufacturers, as their domestic and export prices come under more (or less) pressure depending on whether the dollar appreciates (or depreciates) against the U.S. dollar.

Manufacturing has adapted to changes in the economic environment and has shown considerable resilience in the face of challenges, whether from demand shifts, relative price shifts or changes in tariff regimes. Over the past 45 years, manufacturers have dealt with Canadian and U.S. recessions, trade liberalization (including the introduction of NAFTA), and the largest resource boom since the end of the Second World War associated with a dramatic change in the relative prices of outputs and inputs. Throughout all of these events, manufacturers grew their output at basically the same pace as the rest of the economy, raised their productivity by an annual average of 1.1%, shifted manufacturing shares to match those of the United States and moved to producing more durables, and fewer non-durables, in the face of intense international competition and rising resource prices.

Industrial strategy, in the way of trade liberalization and the intensity of competition from foreign producers, has dramatically reshaped opportunities for expansion in U.S. export markets. The most dramatic change here came from the implementation of the free trade agreements in 1989 and 1993. This period saw both the largest relative and absolute gains in manufacturing output.

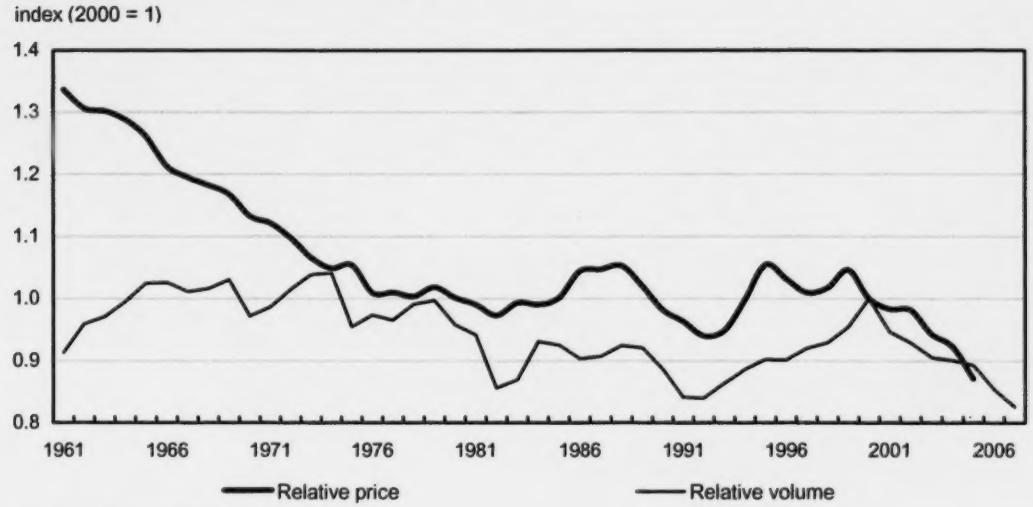
From 1961 to 2000, the manufacturing sector adapted to the many challenges. Some industries have declined in absolute size, but only a few. There was a shift away from consumer non-durables to heavier durable equipment industries and this brought Canada's industrial structure closer to that of the United States.

More recently, new challenges have emerged. Consumer prices for manufactured goods, rather than rising as they did for forty years, declined after 2000. The recent appreciation of the Canadian dollar associated with the resource boom has moved Canadian prices in U.S. markets well above historical trends, putting new pressures on domestic production. Domestic manufacturing volumes in many industries held up because the resource boom offered them offsetting markets.

Recent developments offer new challenges, but it is too early to discern whether they signal a change in trend or only reflect short-run dynamics coming from exchange-rate and business cycles.

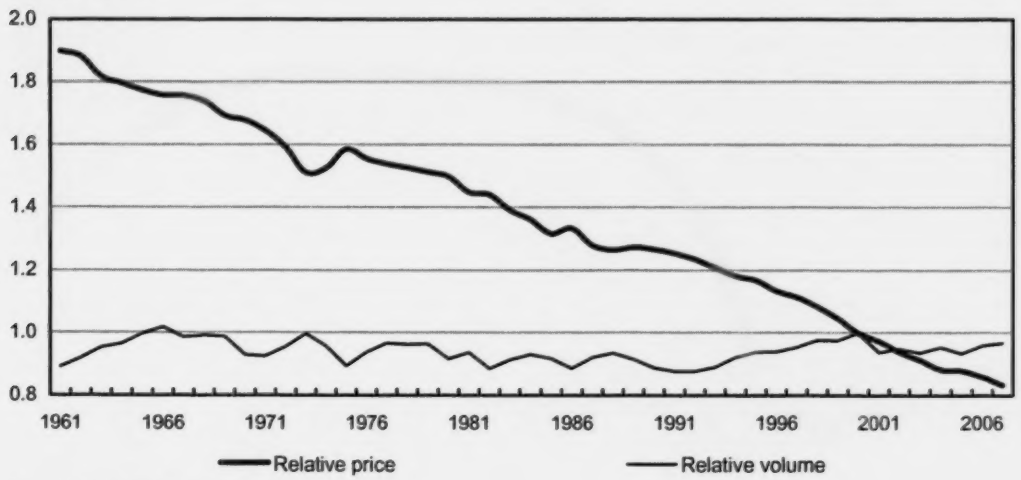
Appendix 1

Chart 1.1
Relative price and volume changes, Canada



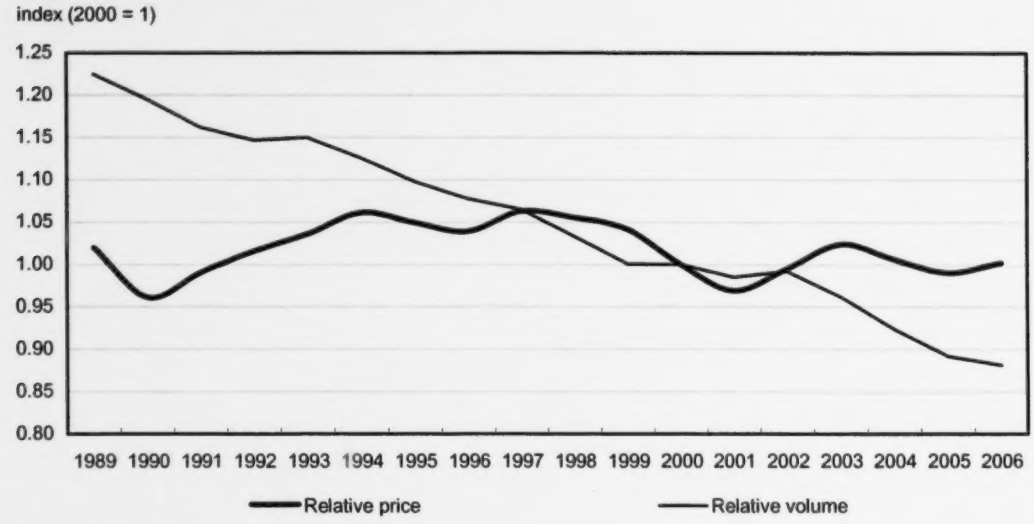
Source: Statistics Canada.

Chart 1.2
Relative price and volume changes, United States



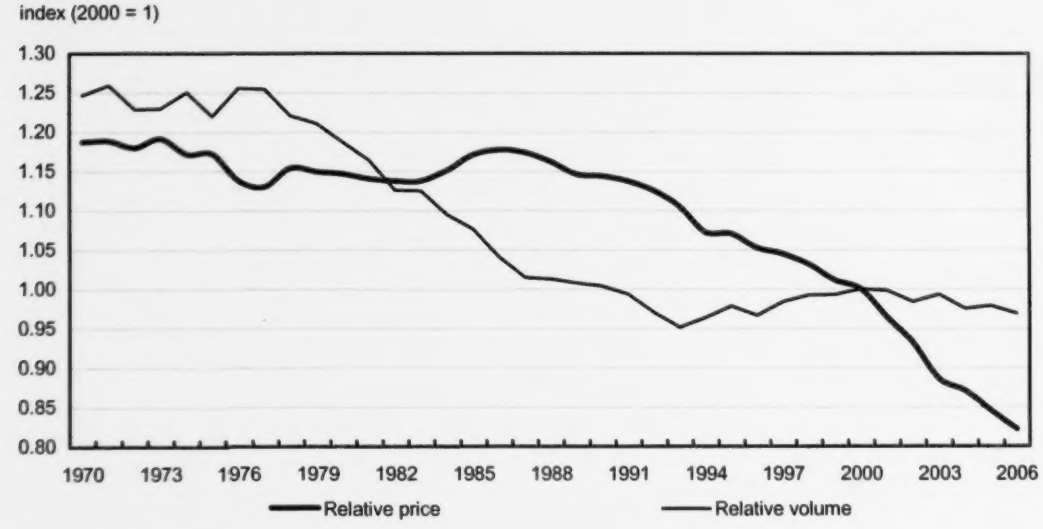
Source: Statistics Canada.

Chart 1.3
Relative price and volume changes, Australia



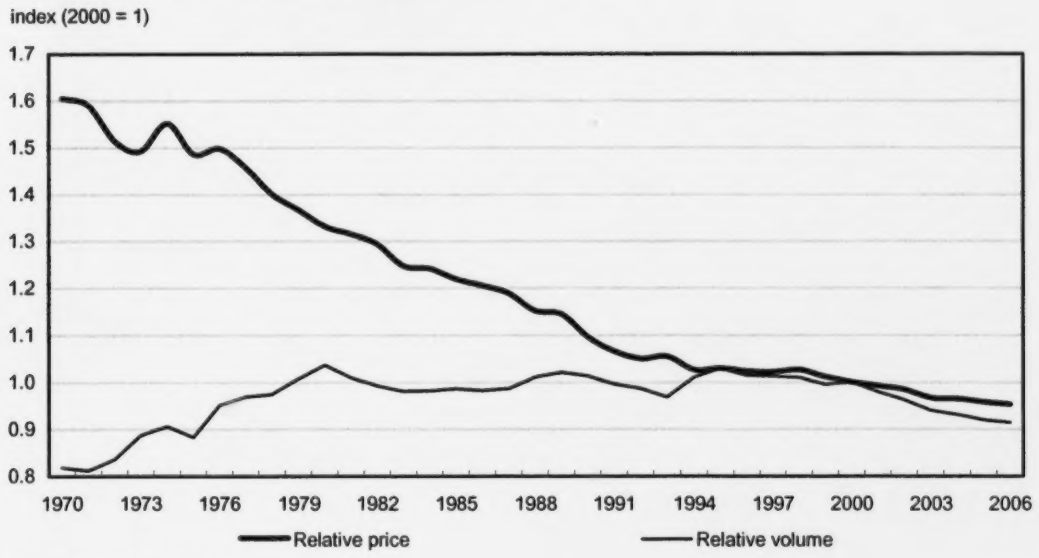
Source: Statistics Canada.

Chart 1.4
Relative price and volume changes, France



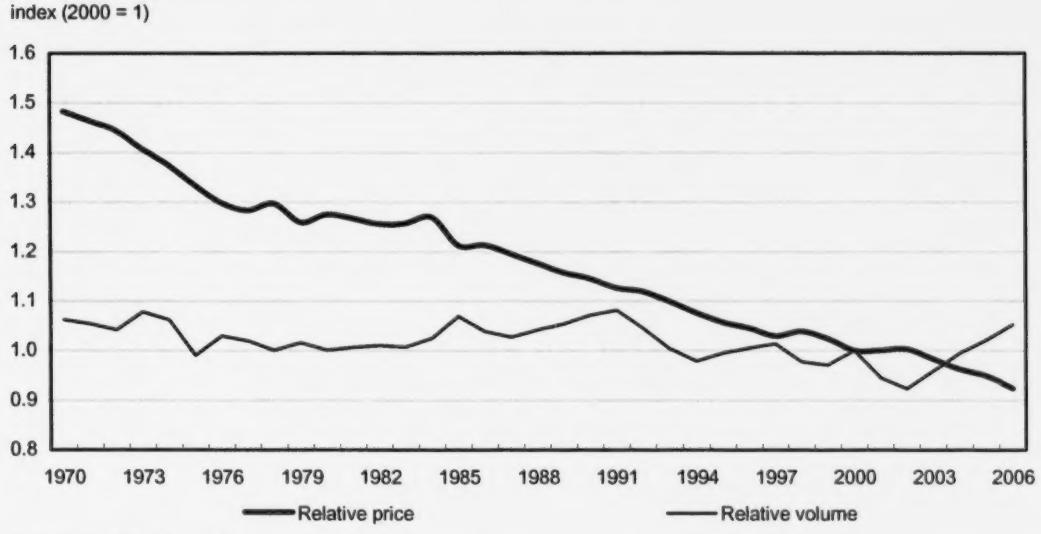
Source: Statistics Canada.

Chart 1.5
Relative price and volume changes, Italy



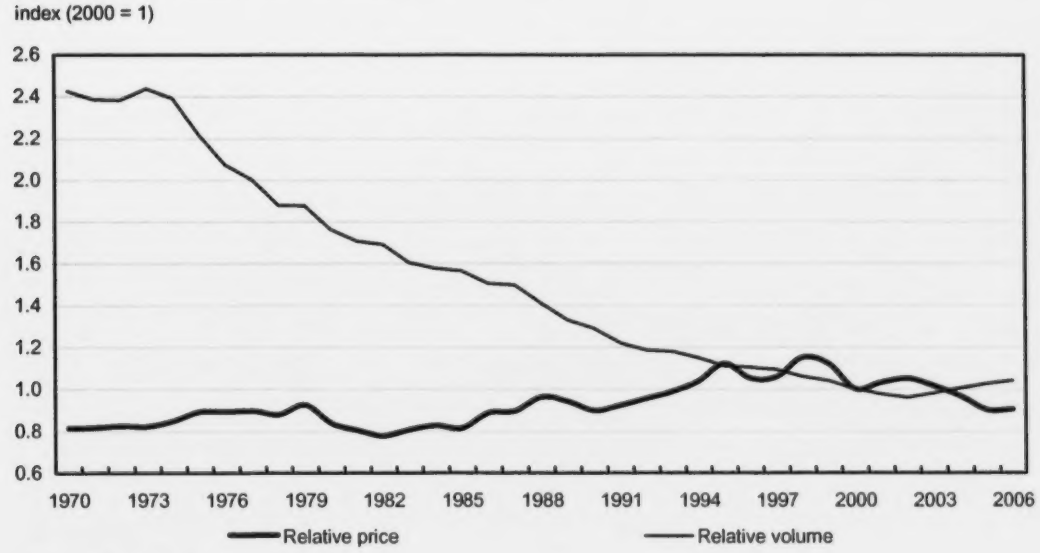
Source: Statistics Canada.

Chart 1.6
Relative price and volume changes, Japan



Source: Statistics Canada.

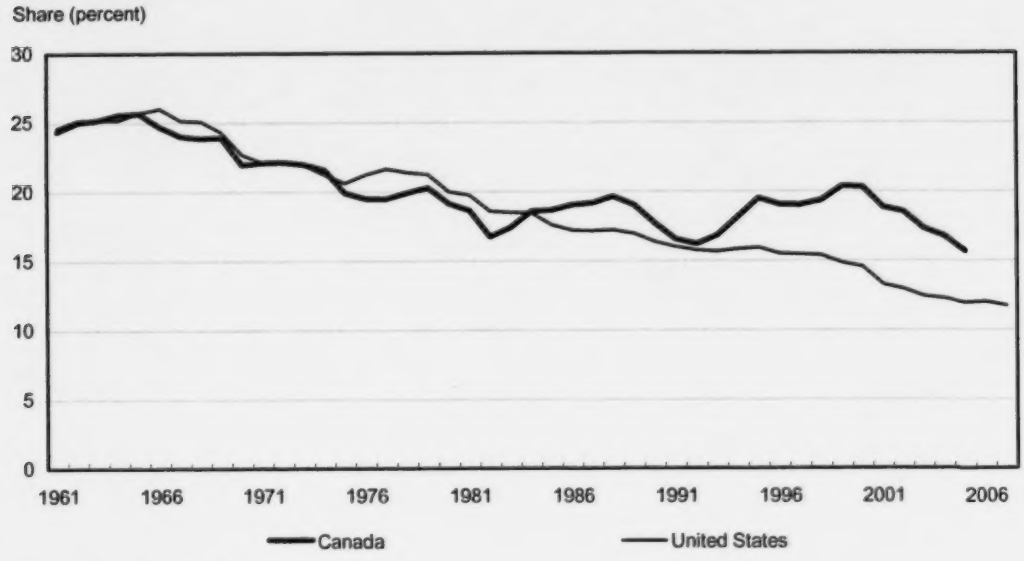
Chart 1.7
Relative price and volume changes, Norway



Source: Statistics Canada.

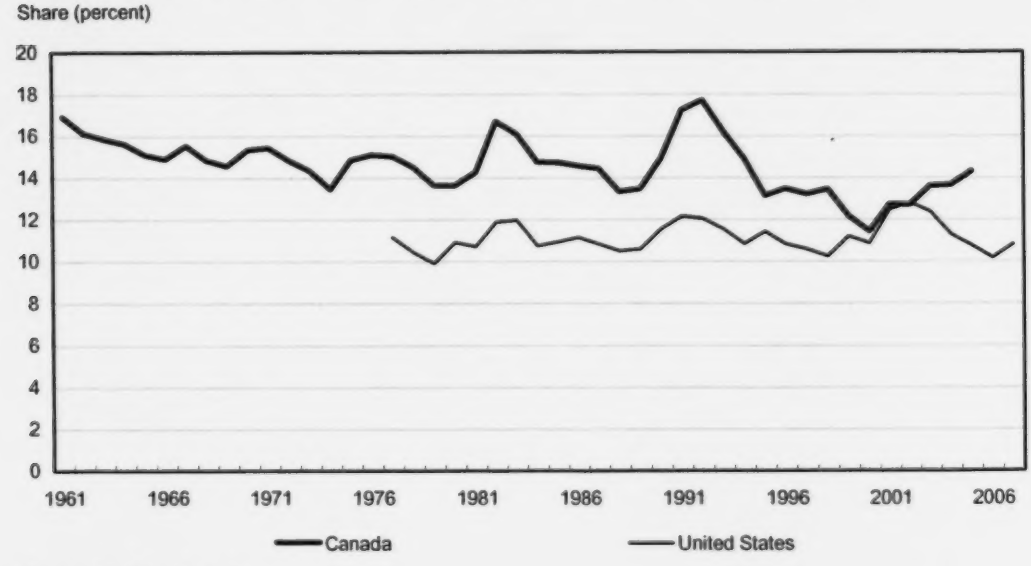
Appendix 2

Chart 2.1
Manufacturing industry's shares of gross domestic product, Canada and United States



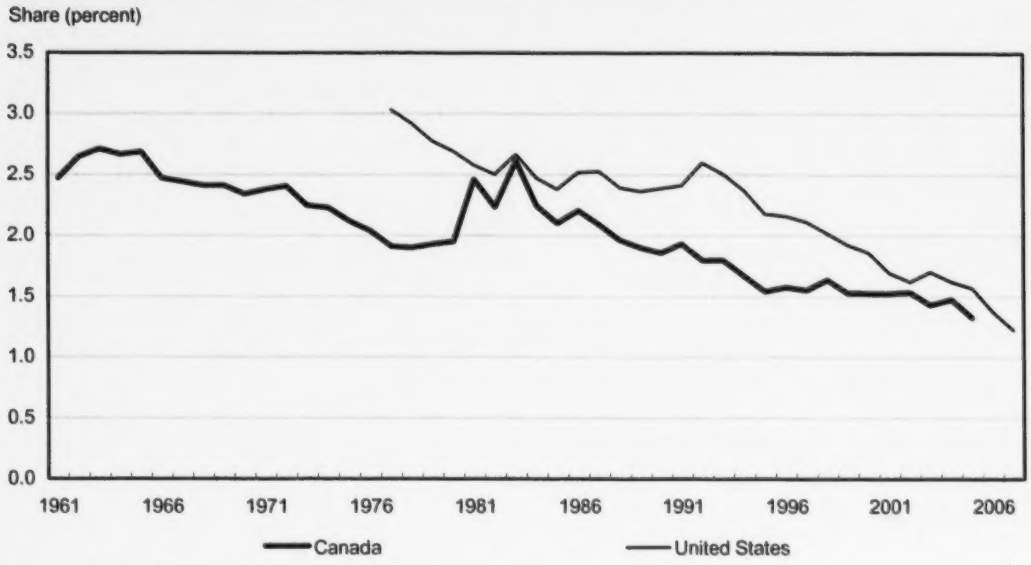
Source: Statistics Canada.

Chart 2.2
Food industry's share in manufacturing, Canada and United States



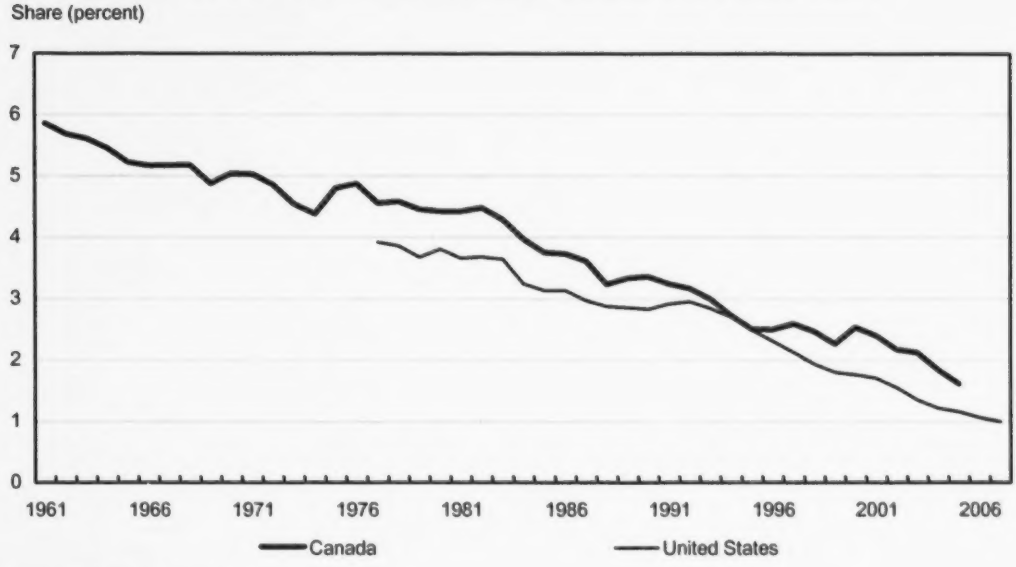
Source: Statistics Canada.

Chart 2.3
Textile industry's share in manufacturing, Canada and United States



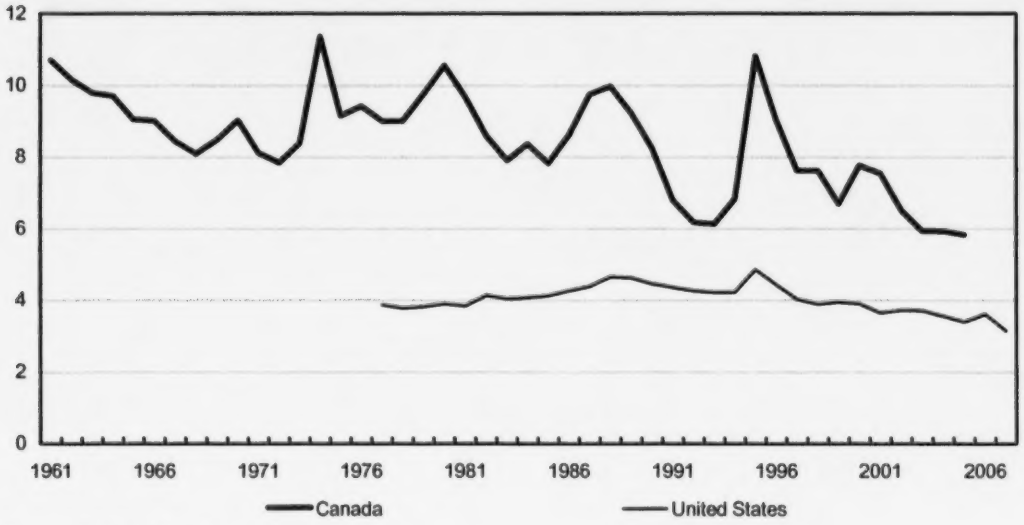
Source: Statistics Canada.

Chart 2.4
Apparel industry's share in manufacturing, Canada and United States



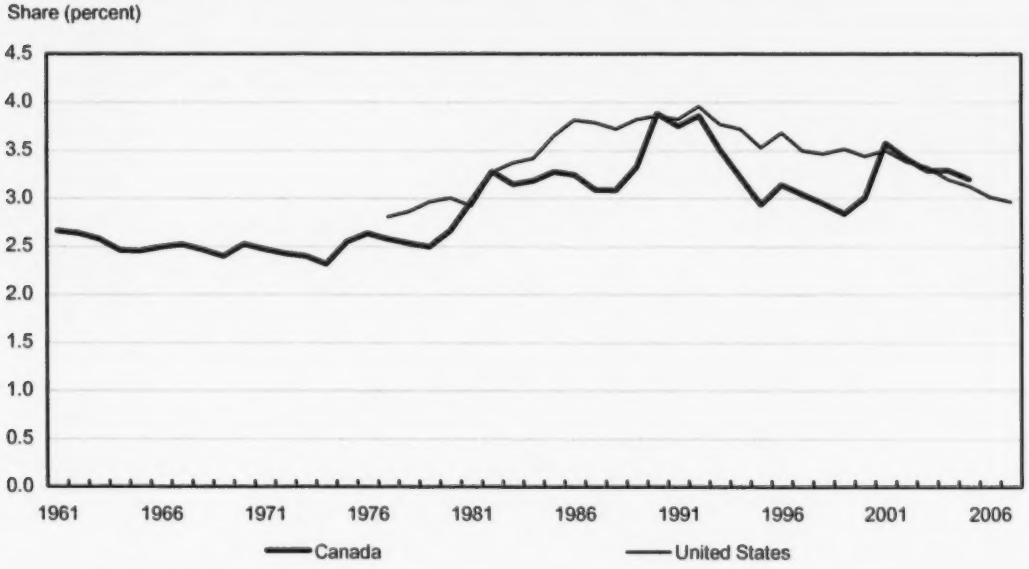
Source: Statistics Canada.

Chart 2.5
Paper industry's share in manufacturing, Canada and United States



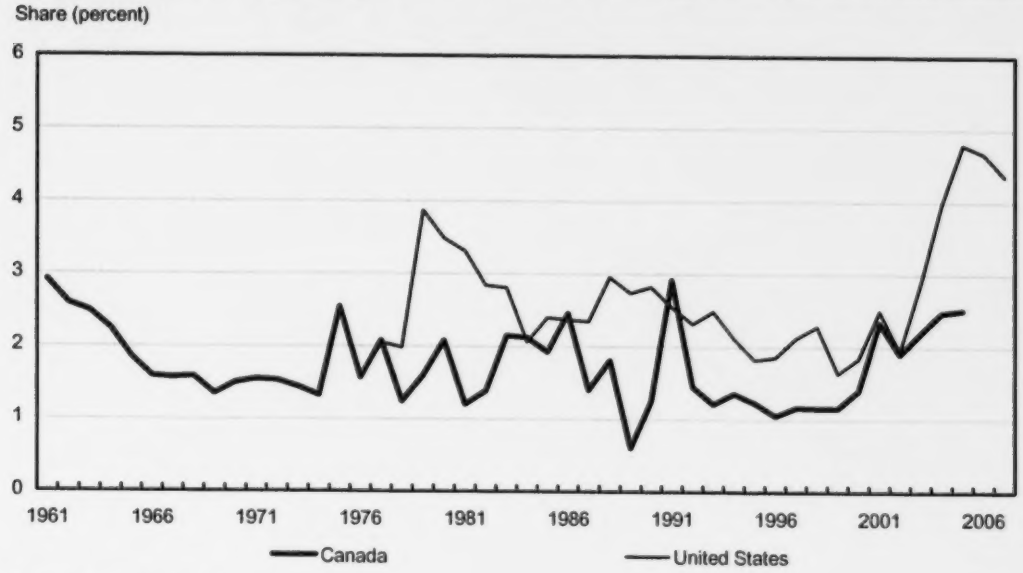
Source: Statistics Canada.

Chart 2.6
Printing industry's share in manufacturing, Canada and United States



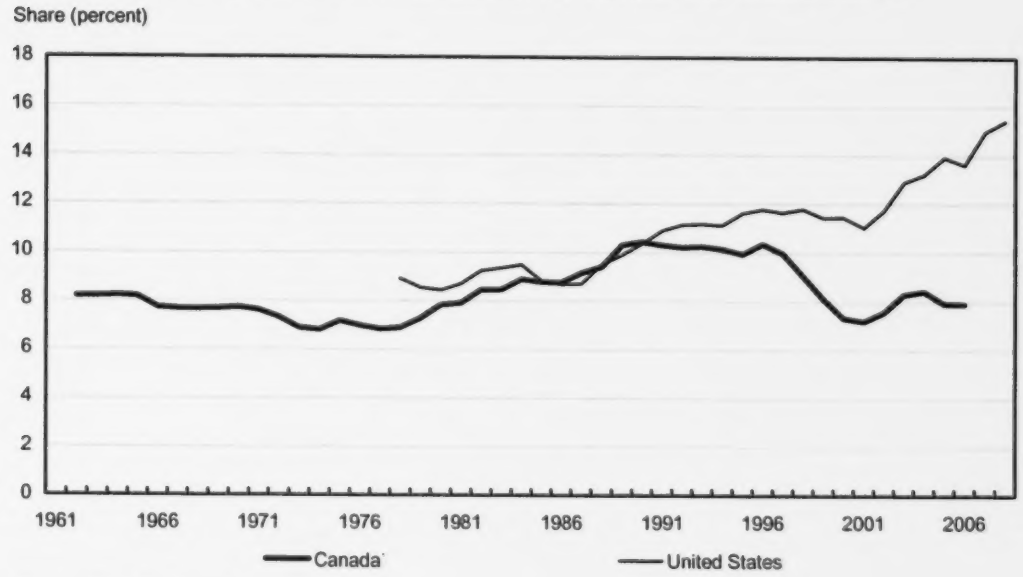
Source: Statistics Canada.

Chart 2.7
Petroleum and coal industry's share in manufacturing, Canada and United States



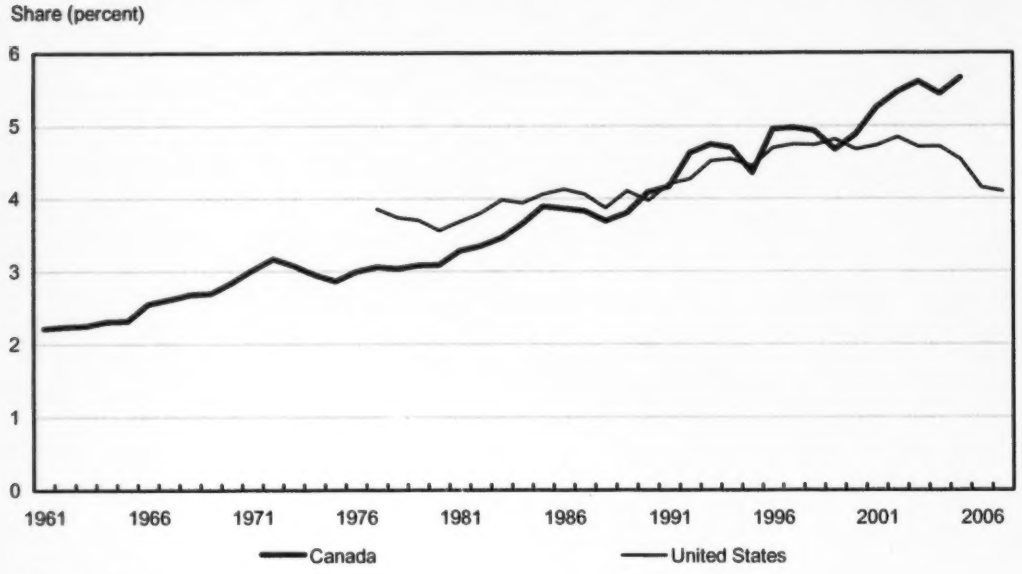
Source: Statistics Canada.

Chart 2.8
Chemical industry's share in manufacturing, Canada and United States



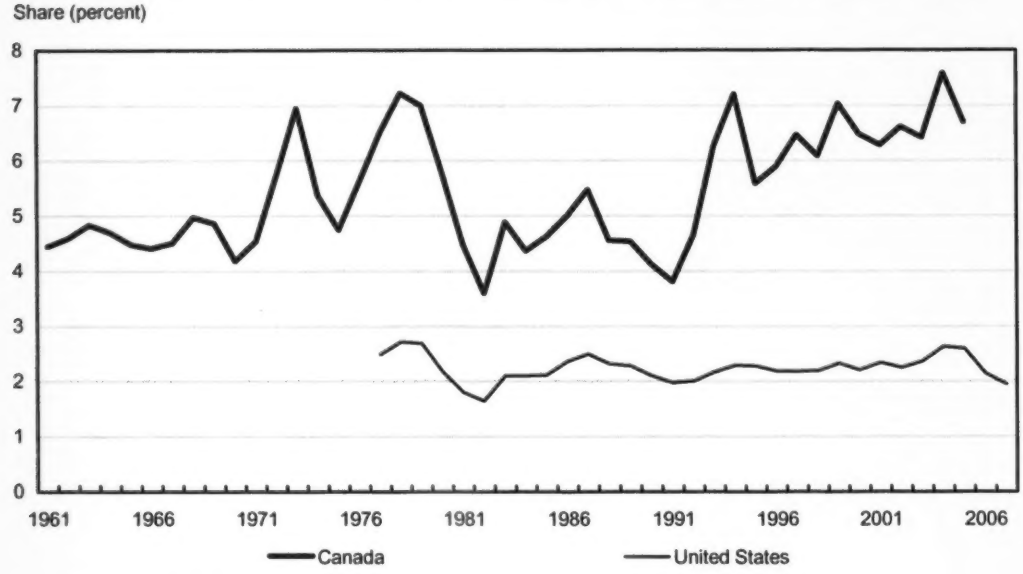
Source: Statistics Canada.

Chart 2.9
Plastics and rubber industry's share in manufacturing, Canada and United States



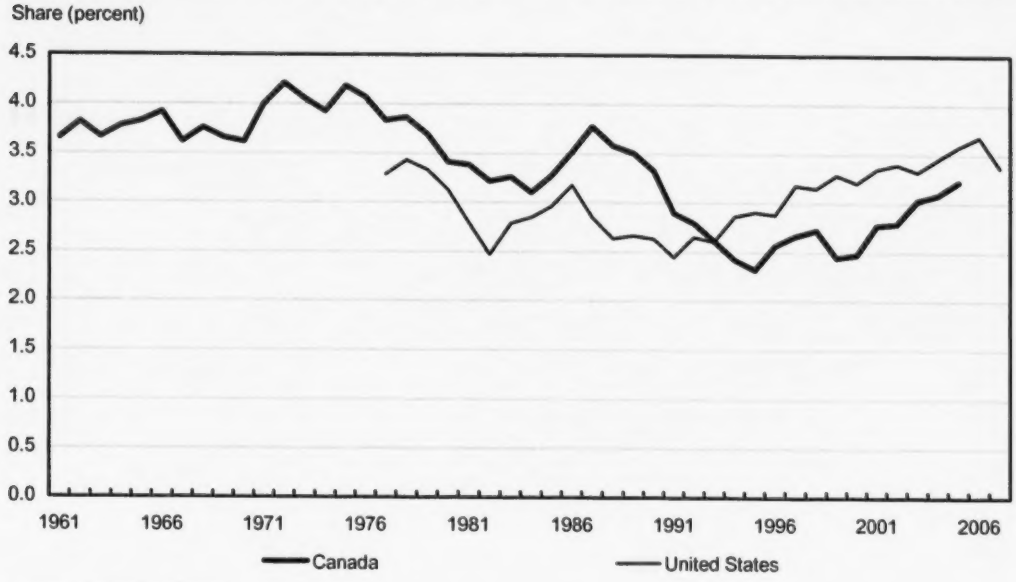
Source: Statistics Canada.

Chart 2.10
Wood products industry's share in manufacturing, Canada and United States



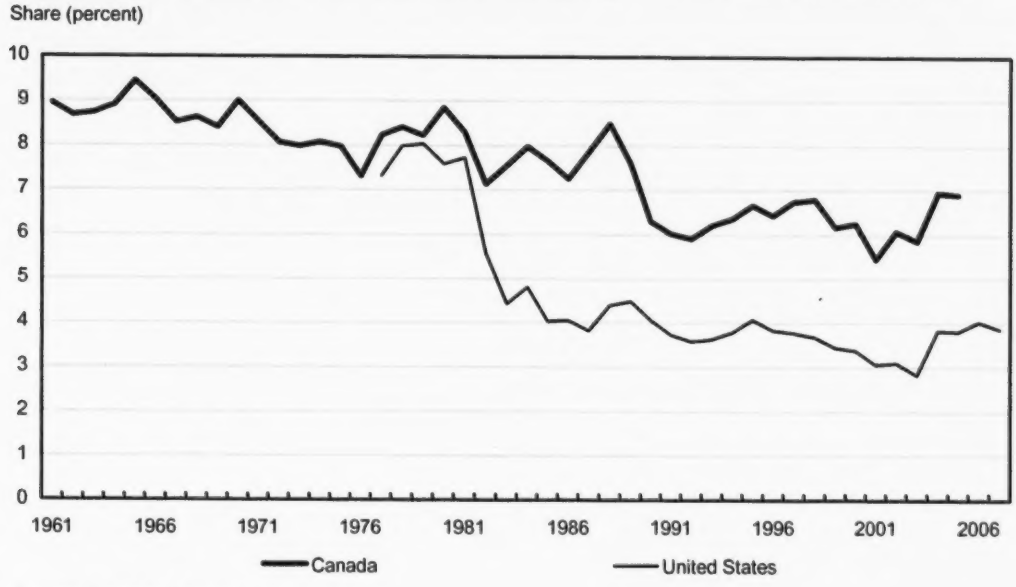
Source: Statistics Canada.

Chart 2.11
Non-metallic minerals industry's share in manufacturing, Canada and United States



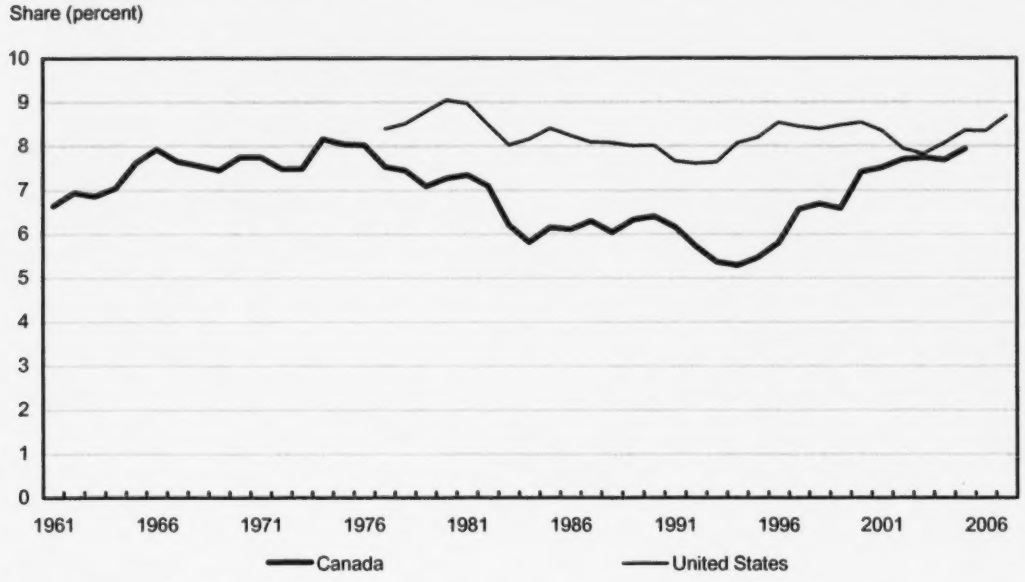
Source: Statistics Canada.

Chart 2.12
Primary metal industry's share in manufacturing, Canada and United States



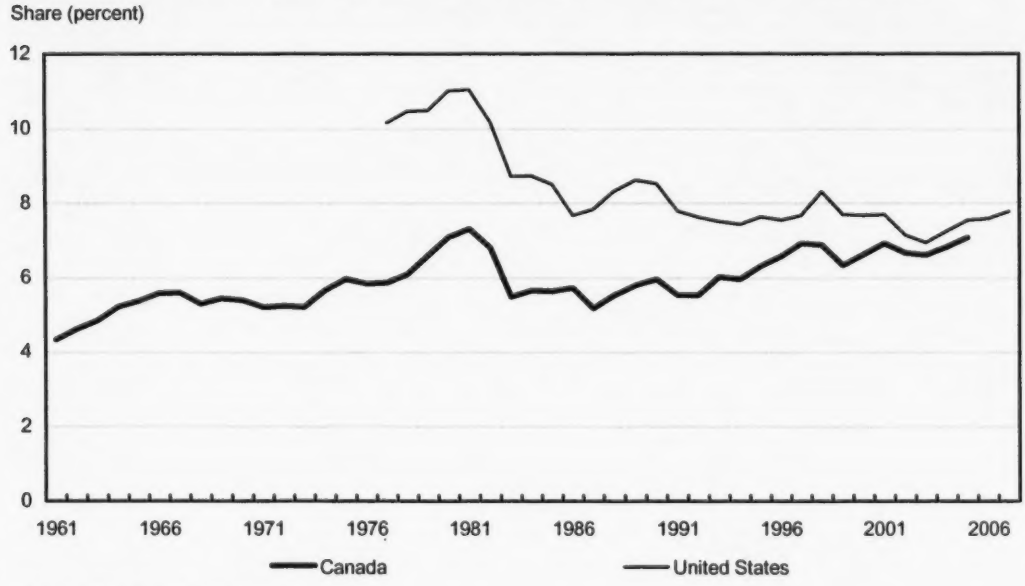
Source: Statistics Canada.

Chart 2.13
Fabricated metal industry's share in manufacturing, Canada and United States



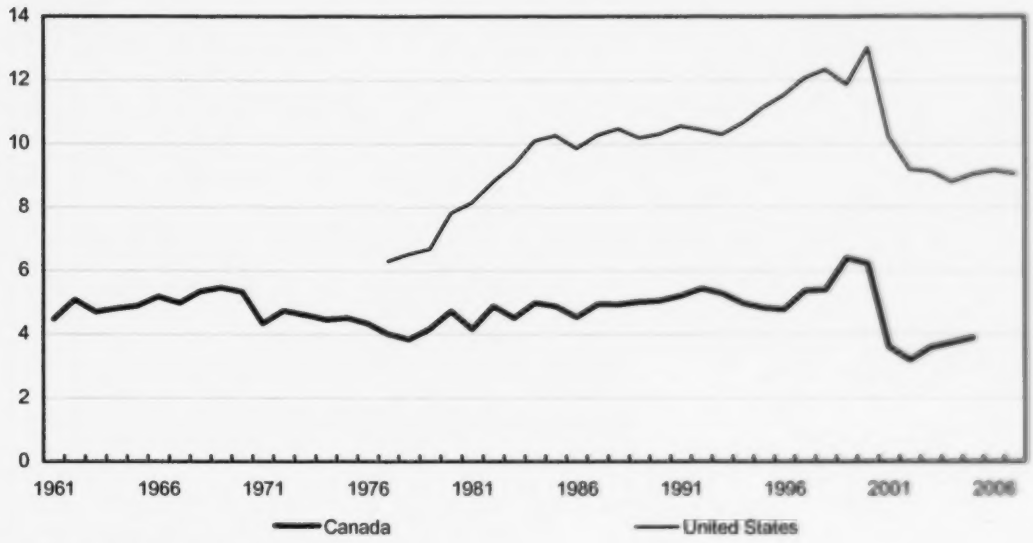
Source: Statistics Canada.

Chart 2.14
Machinery industry's share in manufacturing, Canada and United States



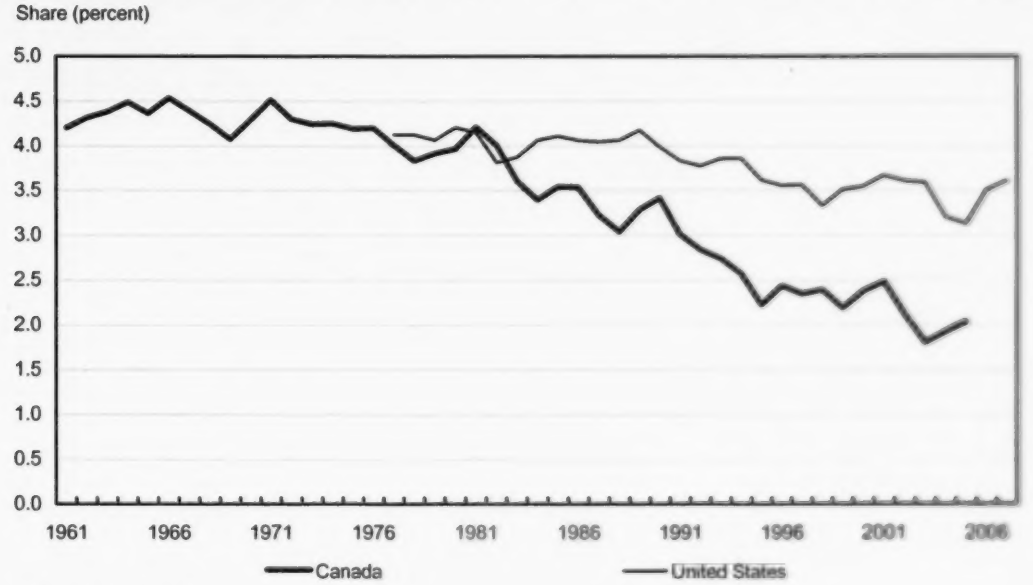
Source: Statistics Canada.

Chart 2.15
Computer industry's share in manufacturing, Canada and United States



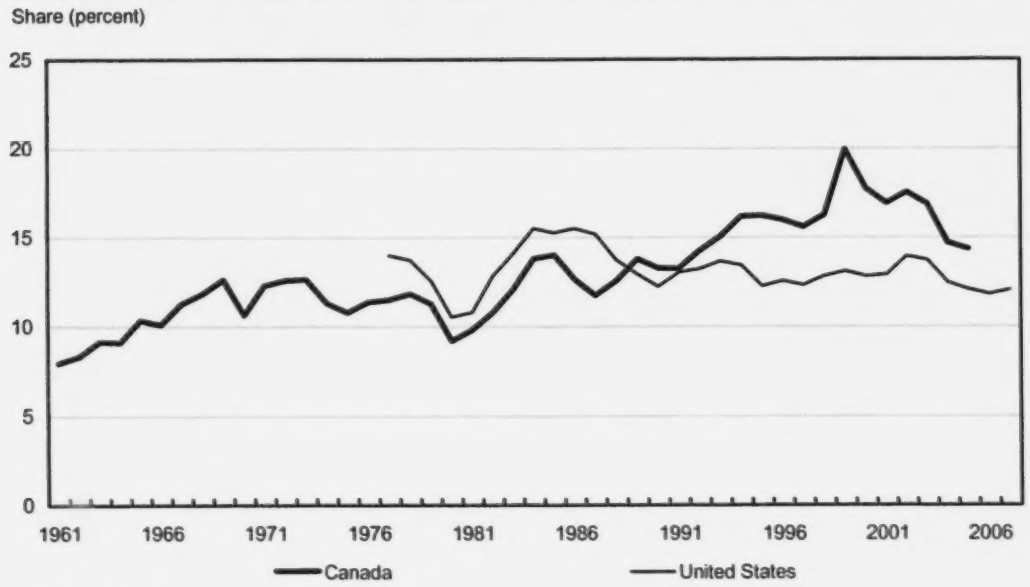
Source: Statistics Canada.

Chart 2.16
Electrical equipment industry's share in manufacturing, Canada and United States



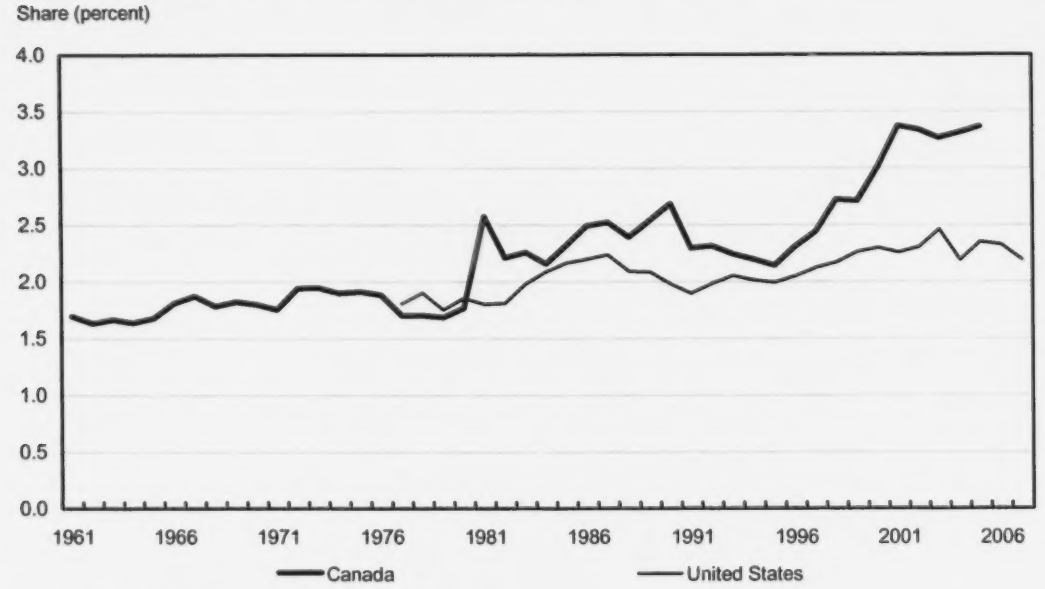
Source: Statistics Canada.

Chart 2.17
Transportation industry's share in manufacturing, Canada and United States



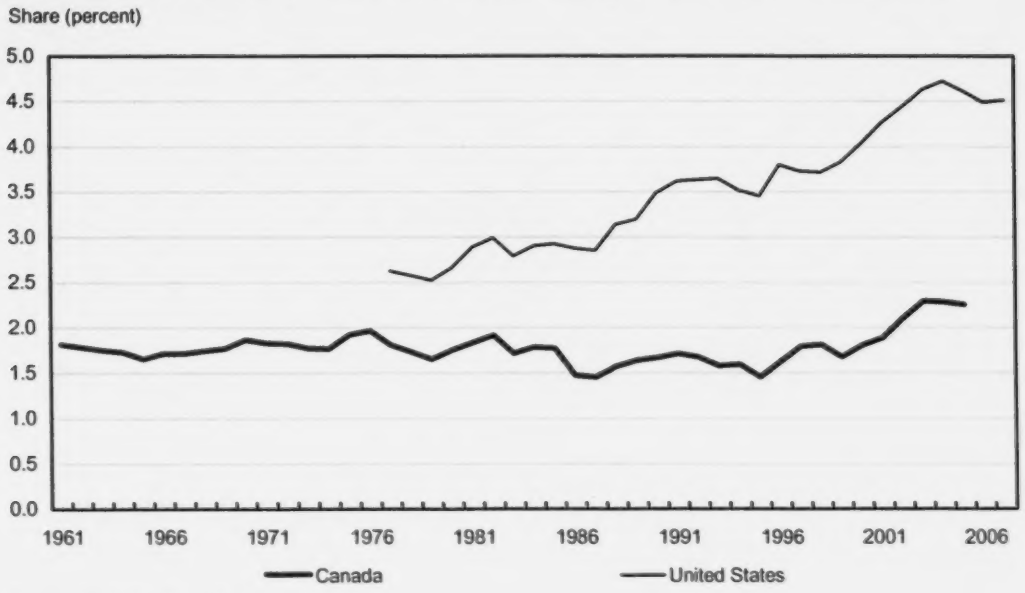
Source: Statistics Canada.

Chart 2.18
Furniture industry's share in manufacturing, Canada and United States



Source: Statistics Canada.

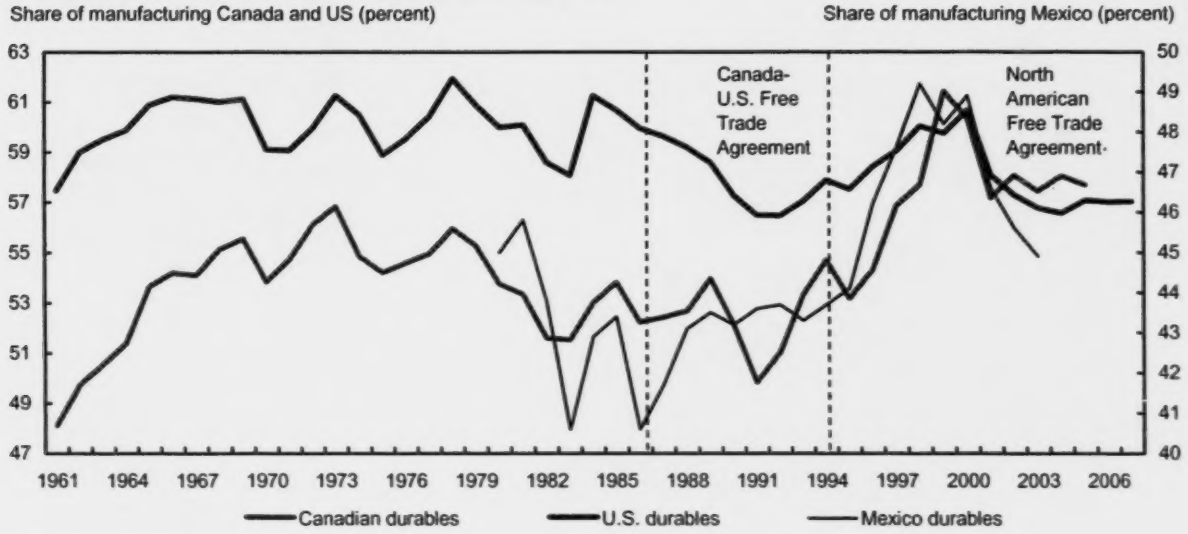
Chart 2.19
Miscellaneous industry's share in manufacturing, Canada and United States



Source: Statistics Canada.

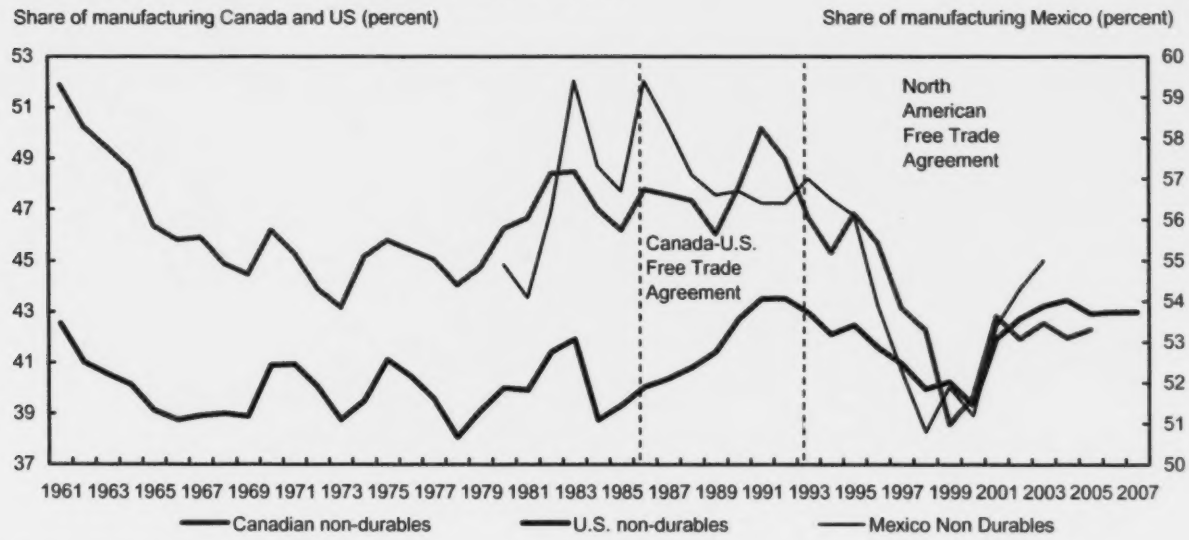
Appendix 3

Chart 3.1
Canada, the United States and Mexico in NAFTA



Source: Statistics Canada.

Chart 3.2
Canada, the United States and Mexico in NAFTA


Share of manufacturing Canada and US (percent)
Share of manufacturing Mexico (percent)
North American Free Trade Agreement
Canada-U.S. Free Trade Agreement
Canadian non-durables
U.S. non-durables
Mexico Non Durables

Source: Statistics Canada.

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